Evaluation of Pb Metal in Organic Waste and Cattle Grazed in Tamangapa Landfill, Makassar, South Sulawesi, Indonesia

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ABSTRACT

In Tamangapa landfill, the cattle consume organic waste as the feed which is susceptible to be contaminated by Pb metal. When the feed is consumed, Pb metal accumulated in the body cattle, it can be endanger the health of the cattle even the people who consume the meat. This study was aimed to measure and examine the content of Pb metal in the cattle which grazed inside and outside the landfill. This study materials included organic feed, leachate water, blood and feces from five cattle that grazed inside and outside the landfill, as samples. Pb metal testing to the samples was performed by using Atomic Absorption Spectrophotometric (SSA) method. The results of analyses described as follows: (a) in the waste feed was found the Pb metal contents are 0.99ppm and 0.16ppm inside and outside the landfill, respectively. (b) in blood cattle were 2.75 ppm and 1.98 ppm for grazing inside and outside the landfill, respectively. It should be notable that in both places, the Pb metal content in the blood cattle exceed the standard value 0.1 ppm. (c) in feces cattle was 2.014 ppm and 1.27 ppm for the cattle that grazed inside and outside the landfill, respectively, the was no difference of the Pb metal level in the blood cattle, however, the difference of the average of Pb metal content in beef feces cattle has been found. Thus, it is concluded that the organic waste in the Tamangapa landfill is feasible as cattle feed but leachate water which as a source of drinking water is not feasible to consume by the cattle. Pb metal contenton blood cattle grazed inside and outside the landfill is different respectively, However, the Pb contenton feces cattle in inside the landfill is higher than outside the landfill.

KEYWORDS
Pb Metal, cattle, landfill

INTRODUCTION

Tamangapa landfill is the final dumping place for all waste in Makassar City since 1992. With a land area of ± 16.8 ha, the garbage is managed from the source to final stage in management and disposal. [1] Showed that the physical characteristics and composition of garbage in the landfill consist of organic 80, 71% waste, 9,23% plastic, 7.03% paper, 0.03% fabric, 0.17%, 0.22% glass, 2.12% cans/iron, 0.50% rubber. Generally, garbage comes from the market, household and other public waste, because of organic waste abundance in the landfill, the farmers use it as feed source. Based on [2] in 2015, the cattle that grazed in Tamangapa landfill reaches 1,600 population. This amount shows the higher interest of the farmers, the higher effort to herd their beef cattle in the landfill.

Waste can be categorized into organic and inorganic waste [3]. In a landfill, there are often some kinds of waste that are not cattle feed, such as plastic bags, rubber sandals, paper, and so forth, but consumed by cattle. This may cause the cattle vulnerable to be contaminated with Pb, aside from the main natural or anthropogenic
source of Pb metal [4]. The source of Pb metal in farm area can come from air, water and animal feed as well [5] and increased contaminant levels in the marine environment [6]. Conventionally, Pb is a heavy metal that often causes poisoning in ruminants. In cattle body, the metal is absorbed by the blood, thereafter binding to the blood protein which is distributed throughout the body tissues [7]. Heavy metals are chemical compounds that can enter through the food and accumulate in the body within a certain period of time and then can cause health problems to the cattle [8]. Heavy metals can also cause disturbance effects on human health, depending on the location and dose of exposure to metals. Toxic effects of heavy metals will be able to inhibit the action of enzymes, and therefore, their presence in human or animal body can interfere the body metabolism that will cause such allergies, mutagenic, teratogens or carcinogens [9]. Various types of decomposed waste will produce leachate which is as a source of drinking water for the cattle that grazed in the landfill. However, leachate can consist of organic materials as well as inorganic materials where the inorganic materials may include heavy metals such as Pb and Cd [10].

[11] Showed that the content in the blood of cattle that grazed in the mining area in Nigeria, averagely of 5.755 ppm and on the surrounding area, the average level of Pb in vegetables, soil and water were 51.343, 46.039 and 1.301 ppm respectively. Pb levels in vegetables and fruits are higher in industrial areas than those on the highway pathways, and the lowest in rural areas showed that in Egypt, Pb level in organ cattle (i.e. meat, liver, kidney, lymph and heart) were highest in the industrial areas and highways and lows in rural as well [12].

The garbage in Tamangapa landfill consists of organic and inorganic waste which can be contaminated by Pb metal and could be a toxic when they are consumed by the cattle. Based on this reason, an investigation on content of Pb in feed and drinking water source in Tamangapa landfill should be conducted. The investigation was performed by examining and comparing the content of Pb in blood and feces of the cattle that grazed inside and outside the landfill.

MATERIAL AND METHOD

1. This research was conducted from March to July 2018 in Tamangapa landfill and the surrounding area. Meanwhile, Pb analysis was carried out at Chemical and Livestock Feed Laboratory of Animal Feed, Faculty of Animal Science, Hasanuddin University, Makassar.

2. In this study we used the materials as follows: organic waste from Tamangapa landfill, blood and feces of cattle that grazed inside and outside the landfill. The materials have been used for Pb analysis. During a period of collecting and analyzing the materials, we use some tools like plastic enclosures/ plastic containers where feed and feces and Leachate samples, tube spoit and syringes, test tubes (EDTA), and tools used for Pb analysis based on [13] and Quantification [114].

Feed samples are a mixture of new garbage and old garbage was taken for 5 consecutive days when the cattle was grazed at the landfill. The new waste is related to the new garbage down from the garbage truck while the old waste to the garbage that has been mixed with the soil and other old garbage, the garbage is then homogenized, weighed ± 300 grams/day, dried and then put into plastic enclosures. On the fifth day, all of the waste samples are homogenized. The leachate water was been taken with plastic tube each ±100 ml at three locations, that is, in outer-, middle-, and near the center of garbage disposal. And then the content of Pb in both samples of garbage and leachate feed was analyzed.

Five cattle those aged over two years that grazed in the landfill since calf period has been used as cattle sample. The blood cattle was taken in their jugular vein by using 5 ml spoit needle, and then, their blood sample was inserted into vacuum tube (EDHA) that contain anticoagulant. The fecal samples ± 300 gram/cattle, and then put into a closed plastic container. To keep the temperature stable, blood and feces samples are fed into the cool box then taken to the Laboratory for analysis. Testing of Pb level on blood and fecal samples were perform by using Atomic Absorption Spectrophotometric Method based on [13] and Quantification [14]. For a comparison, blood samples and feces fecal from five cattle that grazed outside the landfill by using similar techniques as described above.

Analysis of data on blood and feces of cattle that grazed inside and outside the landfill were performed by using statistical test of Hypothesis of Independent Sample, T-test. The results of heavy metals analysis on feed and cattle were then compared with prevailing food safety standards.

RESULT AND DISCUSSION

Table 1: Pb content in organic waste feed and Leachate in Tamangapa landfill, Makassar.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Pb content (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic waste</td>
<td>0.99</td>
</tr>
<tr>
<td>Leachate</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Source: analysis conducted at Livestock Feed Chemical Laboratory, Hasanuddin University, 2018

Table 1 showed that content of Pb metal in organic waste and leachate in Tamangapa landfill, Makassar. We found that content of Pb in the waste is about 0.99 ppm. This value is lower than maximum standard of Pb
metal tolerated in the feed (National Research Council, Canada) [15] and Indonesian National Standard (SNI) 3148.2:2009 [16]. However, the content of Pb in leachate about 0, 16 ppm, higher than standard drinking water of World Health Organization [17], Indonesian National Standard (SNI) 7388:2009 [16] and NRC (National Research Council, Canada) [15].

The content of Pb found in the organic feed at Tamangapa landfill is not different greatly with investigation [17] that found Pb content in garbage at Jatibarang landfill is about 0.42–1.63 ppm which is lower than in old waste, 13.98–7.09 ppm. Pb content in organic waste feed at Putri Cempo landfill about 12.34 ppm [18]. Tolerance of Pb content in animal feed typically is about 30 mg/kg [19]. Although Pb content in organic waste feed at Tamangapa landfill is low, but Pb can accumulate in cattle bodies. The grass contaminated by heavy metals could be a cause of heavy metal accumulation in the body of cattle consuming it [20]. Organic waste feed was consumed by cattle such as banana peel, corn cob, vegetable stem, spinach, mustard and banana leaf, eggshell, wheat flour, vegetable cut, residual food and various types of crops. Organic waste then mixed with inorganic waste such as plastic, rubber, food packaging paper and so forth. Chronic poisoning will be occurred when heavy metals consumed in a long time and continuously, even though in low doses [19]. Pb poisoning can be occurred since the Pb able to change protein that will inhibit calcium absorption and replace zinc as an enzyme [21]. Considerable high content of heavy metal such as Pb metal has been reported as a result of several industrial or waste disposal activities in some regions [22]. We found that the content of Pb in leachate water in Tamangapa landfill higher than that found in Jatibarang, 0.082–0.096 ppm [17]. Meanwhile, the maximum limit of Pb in the drinking water that recommended [23] [24] [16] are 0.05, 0.1, and 0.01 ppm respectively. The content of Pb in leachate water at Tamangapa landfill indicate that leachate water is not suitable to be a source of drinking water for the cattle. In addition, the leachate water smells and blackish brown. The decomposition process produce leachate, where the leachate contain organic as well as inorganic materials. In this case, inorganic materials may contain heavy metals such as Pb and Cd [8]. When the cattle consumed leachate for the long term, Pb metal will be accumulated in the cattle’s body. Therefore, it needsto be careful attention for feeding to livestock [22].

![Comparison of Pb Content on cattle raised in and out Tamangapa landfill](image)

**Graphic 1:** Pb content on organ cattle that raised in and outside Tamangapa landfill, Makassar.

Graphic 1 showed that contenton blood and feces of cattle that grazed inside are higher than outside the landfill. However, both location are higher than standard of Pb level for the cattle needs. The average Pb content in the blood was 2.75 ppm and 1.98 ppm that grazed inside and outside the landfill respectively. The content of Pb on feces cattle were 2.01 ppm and 1.27 ppm inside and outside the landfill, respectively.

Independent sample T-test showed that Pb level of cattle organ that grazed both inside and outside the landfill was not differ respectively. By this research, we observed that organic waste feed did not significantly affect the content of Pb. However, leachate water as a source of drinking water significantly contribute to Pb content on organ cattle that grazed in the Tamangapa landfill.

Pb content was found on blood cattle that grazed in the landfill is higher than the out of the landfill. However, those indicate an existence of Pb metal in body cattle. Pb content in cow blood in Suwung Denpasar TPA varies between 0 and 10.291 ppm [25]. grazing cattle in open area showed that average of Pb content in blood cattle is 0.129 ppm, which is higher than the WHO standard value about 0.01 ppm [26]. These high content may be due to high contents of pollutants in those areas. For grazing cattle in Tamangapa landfill, Pb
metal comes from leachate water, in addition from inorganic waste that consumed by cattle accidentally. The habit of licking by ruminant sometimes can be a main cause of poisoning [7]. Pb source can be found in garbage and around farm building. Wrapping paper can contain Pb 10g/kg, plastic made of food wrap paper 20mg/kg, and candy wrappers 7g/kg as well [27]. Pb source also can be found on HVS paper 6.013 ug/g, printing ink 2.012 μg/ml, and fried-food packaging paper 10,466 μg/ml. There is possibility cattle exposed to vehicle fumes on the way from pen to landfill that could be a contributor for Pb content. Heavy metal levels found in some fish species were higher than other samples from Aladja River. Bioaccumulation may be responsible for this observation [29].

For cattle that grazed in outside the landfill, contamination may be derived from concentrates. Contamination of additional feed ingredients commonly used on cattle such as fish meal, bone meal and powdered flour can lead to increased heavy metal contamination [20]. Heavy metal Pb in poultry feed in Texas shows average Pb content is about 0.14mg/kg [30]. Although cattle was grazed in outside the landfill, feed sources in the form of forage are close to highway. Research found that organ such as liver from cattle where grazing in Deli Serdang consuming wild grass as a feed source of Pb concentration is about 1.080 ppm when cattle grazed around roadsidewildly will be contaminated until 1.230 ppm. It is caused by vehicle exhaust emissions that contain Pb. Pb poisoning is often found in livestock farms, especially in livestock that grazed by grazing systems around mining area or near from highway [32]. The lead content in different parts respective order from high to low in roots, stems and leave, pericarps, flowers and seeds, in addition found on harvesting 105 days had the highest lead accumulation in whole plants [33] and [34].

The content of Pb metal in cattle that grazed in landfill is higher than outside the landfill. Pb metal is consumed indirectly by the cattle and will flow immediately through its feces. The content of Pb metal in feces cattle indicates that Pb is not absorbed in the body of the cattle, but transported by blood to organs of their body. As much as 95% Pb in the blood is bound by erythrocytes, 75-80% Pb is excreted through urine, 15% through feces and others through bile, sweat, hair and nails [35]. Only about 5-10% of the amount of Pb entering through food or only 30% will be absorbed by the body, of which only 15% settles on body tissue and the rest will also be wasted along with metabolic waste materials such as feces and urine [3].

Pb metal can enter the body of the cattle, through food, drink and or air, can cause chronic poisoning if the metal accumulated for long term in body cattle, and will be acute poisoning if in high doses. In the long term, the Pc can be harmful to cattle health and can cause health problems even for humans who consume meat or processed products. Heavy metals can cause disturbance effects on human health, depending on the location and dose of exposure to metals. The limits of animal tolerance to heavy metals will vary because the animal's sensitivity to metal toxicity depends on the biological conditions of the animal concerned, i.e., age, health status, pregnancy, breastfeeding and environmental conditions [7]. Among the sign of Pb poisoning are heart attacks, anemia, kidney function, and decreased immunity, low birth weight, and premature birth due to elevated contents of Pb in the blood and urine [36], can affect digestion, heart, immune system, hemolymphs, reproduction, urinary system and system [37]. Hematopoietic systems are highly sensitive to the effects of Pb because they inhibit most of the enzymes that play a role in hem biosynthesis [38]. The study which was conducted in Para, Brazil shows there was cattle death caused by poisoning of energy storage machines that use batteries for power generation. The laboratory test results show the average Pb content in liver and renal of cattle was 93.91 mg/kg and 209.76 mg/kg, respectively [39].

3. Pb content in the organic waste at Tamagapa landfill is feasible for cattle consumption but leachate water is not feasible for a source of drinking water. Pb content on cattle grazed inside and outside the landfill is differ respectively. However, the Pb content on feces cattle in inside the landfill is higher than outside the landfill. Therefore, we need more research to know how long the cattle are grazed in the landfill.

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