OnLine Journal of Biological Sciences

Original Research Paper

Heavy Metal Contents in Beef Cattle Grazing in Landfill of Makassar City, Indonesia

[1]Ambo Ako, [1]Renny Fatmyah Utamy, [1]Syamsuddin Nompo,
[1]Purnama Isti Khaerani, [1]Sema, [2]Rahmawati and [1]Syamsuddin Hasan

[1]*Faculty of Animal Science, Hasanuddin Univeristy, Makassar, Indonesia*
[2]*Agriculture Department Service of Gorontalo Regency, 96139, Gorontalo, Indonesia*

Article history
Received: 14-11-2018
Revised: 11-01-2019
Accepted: 08-02-2019

Corresponding Author:
Ambo Ako
Faculty of Animal Science,
Hasanuddin University, Jln
Perintis Kemerdekaan KM. 10
Tamalanrea Makassar,
Indonesia
Email: Amboako@yahoo.com

Abstract: The study analyzed heavy metal contents found in the beef cattle grazing in Landfill of Makassar City, Indonesia. The experiments samples were obtained from two different periods of grazing. One period was 2- and the other was 5-year-grazing with a total of 15 cattle, grazing in the landfill. Blood, feces, meat and liver were sampled to measure lead and cadmium contents. The result revealed Pb content in organic waste feed was lower than NRC standard; however, leachate was higher than the NRC standard. Pb content of beef cattle samples both 2- and 5-year-grazing period exceeded WHO standard, while Cd content was lower. Organic waste feed has high enough for providing cattle feed. Utilization of Landfill of Makassar City, Indonesia as a grazing area of beef cattle should be conducted in the dry season to prevent the cattle from consuming leachate.

Keywords: Cadmium, Lead, Leachate, Waste Feed

Introduction

The growth rate of cattle in urban areas is caused by a lack of pasture due to the shift of function from native pasture to horticulture and crop fields or settlements. Therefore farmers prefer to keep their livestock with a cut-and-carry system rather than grazing. Landfill is the cheapest way for grazing however it has potential with a heavy metal content such lead (Pb) and cadmium (Cd) (Putra *et al*., 2018; Wardhayani *et al*., 2006).

Landfill of Makassar City in Indonesia exists for grazing because it provides organic waste from vegetables and plants as a source of feed for cattle. However, this is ironic in terms of producing healthy food because the meat derived from these livestock are suspected to be contaminated with heavy metals. Although the contamination of cattle feed by toxic metals cannot be completely avoided from such method, the effects can be minimized for not only animal health but also human health, even at low concentrations (Miranda *et al*., 2005; Björkman *et al*., 2007; Ali *et al*., 2013).

Some heavy metals occur in landfills, such as Pb and Cd. Heavy metal is generally known as a group of metals and metalloids with atomic weights greater than 4 g/cm^3 or 5 times the density of water (Hutton and Symon, 1986). The heavy metals in the human body are minerals which will be toxic even in small amounts. It will be accumulated in the food chain if it is continuously consumed (Demirezen and Urue, 2006; Joseph *et al*., 2017). The content of heavy metals in beef consumed by humans cannot be solely eliminated by cooking. Thus, a further investigation needs to be conducted to find out the accumulation of heavy metals in the beef cattle.

Mor *et al*. (2009) and Suyanto *et al*. (2010) conducted a study to evaluate the influence of heavy metal contaminated on livestock. In this study, the authors focused on Pb and Cd metal only because, both metals are the most contaminating in landfill area. Furthermore, Frans *et al*. (2013) revealed that cattle grazed in the landfill have been contaminated with Pb and Cd, but they are still tolerable. Cattle which are semi-intensive pastured have lower levels of metal contamination than those grazing directly in the landfill. This study aims to analyze the content of Pb and Cd heavy metals in beef cattle grazing in Landfill of Makassar City.

Materials and Methods

Experimental Study

The experiment was conducted from July to December 2017 in Landfill of Makassar City, Indonesia. The experiment samples were grazed in free range area of landfill with 16.8 ha and obtained from two different periods of grazing in the landfill i.e 2- and 5-year-

grazing with a total of 15 cattle. These cattle were born in landfill. 2- and 5-year-grazing consisted of 8 and 7 cattle, respectively. Blood, feces, meat and liver were derived from the sample slaughtered in Slaughtering House of Makassar City. Blood, liver, feces and feed samples were obtained from each cattle animal.

Sample Preparating and Analysing

Waste feed sample was taken and combined randomly from fresh and previous waste for 5 consecutive days at the cattle grazing spot in Landfill of Makassar City, Indonesia. The waste feed was homogenized and weighed as much as ± 500 gram/day and then oven-dried for 5 days. After drying process, the samples were put in a plastic bag and then nutrient content of Pb metal content was analyzed. Nutrient composition analysis was carried out by Proximate Analysis (i.e. dry matter, ash, crude protein and crude fat) based on AOAC (1990) and the analysis of acid detergent fibre, neutral detergent fibre, lignin, cellulose and hemicellulose based on Van Soest (1982). The analysis of Pb metal content in organic waste feed and leachate were carried out by the Atomic Absorption Spectrophotometry method based on Certificated Reference Material (CRM).

Blood and feces of 2- and 5-year-grazing period cattle in the landfill were taken by using sampling techniques as follows: Blood sample was taken on the jugular vein using 5 mL syringe of vacuum tube containing anticoagulants. Cattle feces was taken approximately 300 grams/livestock and then put in a closed plastic container. To maintain the stability of feces temperature, it was put into the cool box before analysing. Meat and liver sample (5 mg each) were taken for laboratory analysis. The test of Pb levels in blood, feces, meat and liver sample were carried out by Atomic Absorption Spectrophotometry method based on Certificated Reference Material (CRM) (2012). Analyzed in triplicates. Heavy metal content was analyzed in Laboratory of Chemical and Livestock Feed, Faculty of Animal Science, Hasanuddin University, Makassar.

Results

Content of Chemical Nutrition

Food waste for livestock feeding is mentioned as waste feed. Waste feed is available for 652 tons/day in Landfill of Makassar City, Indonesia. Waste feed was derived from organic waste containing larva, worm and maggot as a protein source. Although they were being a protein source, waste feed would be accumulated and endangered in cattle. The content of chemical nutrition and Pb metal in waste feed is presented in Table 1.

Content of Pb and Cd Metal

Average of Pb and Cd metal contents in samples of cattle grazing i.e., blood, feces, meat and liver compared to WHO standard (WHO, 1996) are presented in Tables 2 and 3.

Table 1: The content of proximate analyze, Van Soest analyze and Pb metal of waste feed and leachate in Landfill of Makassar City, Indonesia

Proximate analyze (%)*	Content
Dry matter	97.6
Ash	14.8
Crude protein	16.4
Crude fat	7.58
Van Soest (%)*	
Acid Detergent Fibre	35.7
Neutral Detergent Fibre	52.7
Lignin	16.4
Cellulose	16.4
Hemicellulose	16.9
Pb content (ppm)**	
Organic waste feed	0.99
Leachate	0.16

Source: *Laboratory of Chemical and Livestock Feed, Faculty of Animal Science, Hasanuddin University, Makassar (2017); **Rahmawati *et al*. (2018)

Table 2: Pb metal content of beef cattle samples in Landfill of Makassar City, Indonesia

	Pb Content (%)		
Sample	2 YGP‡	5 YGP‡	WHO standard
Blood	2.05 ± 0.001	3.05 ± 0.000	0.10
Feces	2.03 ± 0.011	2.06 ± 0.007	-
Meat	2.00 ± 0.001	2.00 ± 0.001	0.1
Liver	2.01 ± 0.002	3.04 ± 0.002	0.1

YGP: Year-Grazing Period;
WHO standard (1996);
‡Data presented as means ± standard errors

Table 3: Cd metal content of beef cattle samples in Landfill of Makassar City, Indonesia

	Cd Content (%)		
Sample	2 YGP‡	5 YGP‡	WHO standard
Blood	0.04 ± 0.001	0.15 ± 0.001	0.15-0.50
Feces	0.03 ± 0.001	0.06 ± 0.010	-
Meat	0.04 ± 0.001	0.08 ± 0.001	0.15-0.50
Liver	0.03 ± 0.005	0.23 ± 0.001	0.15-0.50

YGP: Year-Grazing Period;
WHO Standard (1996);

ǂData presented as means ± standard errors

Discussion

Content of Chemical Nutrition

The value of proximate analysis (Table 1) was high enough for providing feed compared to Wahyono (2001) which is nutrition composition for fattening consisted of 88% dry matter, 14.7% crude protein and 3.0% crude fat and Ako *et al*. (2016) revealed that agriculture and vegetable waste products can meet the standard for feed requirements of dairy cattle. Even though the crude fat was lower than research of Sudiyono and Handayanta (2010).

Organic waste in a landfill consumed by cattle is dominated by vegetable waste, fruit waste and leftovers food and mixed by decayed inorganic waste. Therefore, not only organic wastes but also plastic materials such as plastic bags, sandals rubber and paper are consumed by cattle. High levels of animal performance and health depends on a high quality of nutrition and management. Nutrition is often limiting the productivity of ruminants selected for high genetic merit (Ulyatt and Waghorn, 1993). The first requirement for determining dietary composition is by obtaining a representative sample of feedstuff. Cattle feed is obtained by grazing land and cut-and-carry system.

Some farmers bring their cattle for grazing in landfill. According to Wardhayani *et al*. (2006) landfill area is often used by farmer as the location of livestock grazing, because the waste could be used as feed for livestock, while the livestock grazing in the environment of Landfill area could also give adverse impacts. Zubair and Haerrudiin (2012) revealed that Landfill of Makassar City consists of 80.71% organic waste; 9.23% plastic; 7.03% paper; 0.03% fabric; 0.17% wood; 0.22% glass; 2.12% can/iron; and 0.50% rubber. The highest level of organic waste in Landfill of Makassar City comes from settlements' garbage such as food waste, kitchen waste, yard waste, market waste, etc. Arifin *et al*. (2003) found that waste feed is unsafe for cattle grazing in landfill.

Pb content of organic waste feed in Landfill of Makasar City (Table 1) was similar to Wardhayani *et al*. (2006) who found 0.42-1.63 ppm of Pb in Jatibarang Landfill. However, it was lower than 12.34 ppm of Pb content which was found in Putri Cempo Landfill (Sudiyono, 2011).

Feed was contaminated by Pb metal found around the waste in landfill of Makassar City. Some feed types containing of Pb metal concentration with not more than 10 ppm can still be tolerated for cattle feeding; however, high concentration at 100 ppm of lead in feed types could be a potential problem (Dai *et al*., 2016). Therefore, waste feed in Landfill of Makassar City is safe to be consumed by cattle.

Content of Pb and Cd Metal

Pb content of beef cattle samples in Landfill of Makassar City both 2- and 5-year-grazing period exceeded WHO standard (1996), while Cd content was lower.

Some metals in small quantities are very important for living; however, it can be toxic in large amounts. Heavy metals can cause human health problems and environmental effects (Trang *et al*., 2010; Widowati, 2008). Even though metals are important in organ activities both in growth and reproduction. Losing one of those minerals, will result in symptoms of mineral deficiency (Purnama *et al*., 2014).

Pb metal enters the digestive tract and it is absorbed by the intestine, then enters the blood circulation and binds to blood proteins and is then distributed throughout the body's tissues (Swaileh *et al*., 2009). Besides Pb causes the decrease in nerve conduction velocity, the Pb is not only disrupting nutrient interactions in the body (Malaka, 1994; Darmono, 1999), but also it accumulative and chronic (Yulaipi and Aunurohim, 2013).

The highest Pb contamination is found in the liver (Korenekova *et al*., 2002). Hasan *et al*. (2016) stated that Pb metal was produced by several industrial activities or waste disposal in several regions, while according to Sudiyono (2011), Pb was a component of materials for making plastics, ink in newspapers and fabric dyes.

Most of the garbages are wet waste in Landfill of Makassar City which contains a number of organic substances and it also contains mixed waste form all activities not only from domestic market but also from public. Grazing cattle chooses other waste feed or licks inorganic waste if fresh feed waste was no longer available. Limited pasture and reduced cost of livestock production were the contributing factors for grazing cattle in Landfill of Makassar City.

Landfill of Makassar City found not only inorganic waste such as plastic, paper packaging or cork, wrapping paper and but also water. Besides, the habits of cattle such as licking is cause of poisoning (Darmono, 2001; Milam *et al*. (2015) and Kamala and Kumar (1998) revealed that generally cattle habitats were constantly contaminated with heavy metals due to waste disposal illegal mining.

Pb content in beef cattle sample from cattle grazing in Landfill of Makassar City was higher because the cattle consumed leachate as a source of drinking water in long period while Pb content of leachate exceeded 0.1 ppm NRC standard (NRC, 2011). Rahmawati *et al*. (2018) revealed that organic waste feed did not significantly affect on Pb content. Leachate in Landfill is contaminated by cosmetics, battery, ink in newspapers, etc. However, leachate water as a source of drinking water significantly contributed to Pb content in organ cattle grazed in Landfill of Makassar City. Therefore, to prevent higher Pb content of beef cattle samples exceeding WHO standard, it is recommeded that cattle not be grazing in landfill during the rainy season. Cattle should only grazing in landfill during dry season when forage is not available.

Based on Table 3 Cd content in blood, meat and liver in both 2- and 5-year-grazing periods are not exceeding WHO standard.

Palar (2012) stated that Cd is produced from a polluted environment and found easily in landfill area. Cd is mostly accumulated in kidneys and liver because the level of elimination from these organs was relatively low due to the binding of Cd tissue to metallothionein (ATSDR, 2011; Garcia-Fernandez *et al*., 1996). Cd also causes kidney dysfunction (Solidum *et al*., 2013; Bernard, 2008). Cadmium having reached 50% enters through the digestive tract, around 3-8% is absorbed from the total Cd and absorbed to the intestinal wall of the cattle (Darmono, 1999).

The highest Cd accumulation is at the heart Korenekova *et al* (2002) and such substance threatens the human food chain (Darmono, 1999; Sharma and Street, 1980; Gupta, 2012). However Cd content in beef cattle sample of cattle grazing in Landfill of Makassar City both 2-and 5-year-grazing period were lower than WHO standard.

Conclusion

Organic waste feed in Landfill of Makassar City, Indonesia has high enough for providing cattle feed, because it has high nutrition and heavy Metal (Pb) under NRC Standard. Cd content of beef cattle sample was lower than WHO standard while Pb content exceeded WHO standard which was caused by high Pb content of leachate in Landfill of Makassar City. Utilization of Landfill of Makassar City, Indonesia as a grazing area of beef cattle should be conducted in dry season to prevent the cattle from consuming leachate.

Acknowledgement

The authors would like to express their gratitude to Ministry of Research, Technology and Higher Education of Indonesia through Intitution of Research and Extention of Hasanuddin University. The authors would like to express their gratitude to Head of Makassar City's Slaughterhouse who has given permission to conduct the research in Landfill of Makassar City, Indonesia.

Funding Information

This Manuscript was funded by Ministry of Research, Technology and Higher Education of Indonesia through.

Author's Contributions

Ambo Ako: Conceived the manuscript and performed the field experiments.

Renny Fatmyah Utamy: Conceived the manuscript

Syamsuddin Nompo: Designed the field experiments.

Purnama Isti Khaerani: Conceived the manuscript

Sema: Performed the field experiments and collected data.

Rahmawati: Performed chemical analyzed data.

Syamsuddin Hasan: Conceived and performed the field experiments.

Ethics

This Manuscript has not been published or presented elsewhere in part or in entirely and is not under the consideration by another journal. All the authors have approved the manuscript and agree with sumbission of interest to be declared.

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