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Comparison of lead contamination in innards and muscle tissues of Bali cattle reared in Suwung Landfill

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ABSTRACT

Innards parts are more widely consumed by the public than the muscle parts, or more commonly known as beef. People are aware that the innards contain a lot of cholesterol, but they do not aware about the content of heavy metal lead. This research aims to study lead contamination levels in offal and beef muscle contaminated with lead. A total of five cows with known lead contamination were slaughtered to be examined for the levels of lead. Viscera taken part including the liver, lungs and intestines, which are the commonly consumed part. While the muscle tissues taken were from the costae muscles, which is the tissues with the most blood flow. Level of lead contamination in the innards and muscle tissues were checked using Atomic Absorption Spectrophotometry (AAS) method. The result of the examination was obtained as such: liver = 0.76 ± 0.25 ppm; lung = 1.11 ± 0.08 ppm; intestinal = 0.90 ± 0.29 ppm; and muscle tissues = 0.69 ± 0.13 ppm respectively. It was found that the innards contain more lead than the muscle tissues. It is concluded that the muscle part is safer for consumption than in the innards. It is also suggested that there are the needs for random checks in beef and the innards sold in the market, especially for the presence of lead contamination.

Keywords: innards, muscles, lead, AAS method.
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INTRODUCTION

The demand for beef increases along with public awareness of animal proteins' benefit for health, growth and intelligence. To keep the beef safe to consume, one must starts from the origin of the cattle itself, the way it is butchered, transporting and the handling of the beef, before finally reaches the consumer. Healthy beef comes from healthy cattle, which is free from zoonosis diseases. To be considered as healthy, the beef not only have to be free from disease, but also must be free from inorganic contamination, especially heavy metal. Cattle which are raised in a city landfill have very high risk to be contaminated by heavy metal.[1]

There are many kinds of heavy metal contaminant in cattle. Some of them including lead (Pb), mercury (Hg), cadmium (Cd), and arsenic (Ar). An examination of blood plasma from cattle grown in landfill TPA Suwung Denpasar showed that most of the cattle were contaminated by lead.[2] Level of lead in the cattle's blood are highly correlated to absorption dose, route, and the duration of the exposure.[1] Meanwhile there are trace of lead contamination found in cattle that was butchered in a slaughterhouse in Nigeria, with an average level of 4.36 ± 0.79 ppm.[3] But there were no explanation about what is causing such high level of contamination in the cattle.

Heavy metal lead is very hazardous to human's health. The most common symptom of lead poisoning in human is anemia, because lead acts like a substitution to iron (Fe) in hemoglobin.[3] Anemia occurs because of erythrophagocytosis, which is the next stage of oxidative stress. Lead poisoning can also cause kidney and liver dysfunction,[4] apoptosis spermatogenesis,[5] permanent immunity deficiency[8] and lowered cognitive growth in children.[3] From the damaged organ or tissues, it is very possible that the lead content level are varied in each part. It is important to know the ratio of lead content level in various tissues of the cattle, so consumer can be more selective in choosing parts of the cattle to be consumed. This study aims to find out the lead content level in the innards parts (liver, kidney, and lungs), compared to the tissues.

METHOD

Sample

Five Bali cattle that were born and raised in landfill Suwung, Denpasar City, in which the blood plasma contain heavy metal lead, were used as sample in this study. All of them were butchered and dissected in Mambal Slaughterhouse, at Badung Regency. The innards parts (liver,

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kidney, and lung) and muscle tissues in the chest area (*costae*) were harvested. Costae muscle were chosen to be harvested because it is the part that is close to intensive blood flow. The innards and muscle parts were taken and then measured for the lead content at analytical laboratory of Udayana University.

Measurement of Lead Content Level

The measurement of lead content in cattle's innards and muscle were done using AAS (Atomic Absorption Spectrophotometric) method. Each of the tissues and muscle were taken from each cattle. Each the tissues of samples were then split into two parts of 0.5ml each; one for positive control, and another as sample. After that, 0.25 ml of 1mg/1 standard solution was added to the sample to create spiked sample or positive control group. The spiked sample were then heated on a hot plate in a temperature up to 100°C until it was dried up. Sample and spiked were put in an ashing furnace and half of the surface were closed. The temperature was slowly risen by 100°C every 30 minutes up to 450°C and then maintained for 18 hours. The sample and spiked were taken out after, and were let cooling down in room temperature. After that, 1ml of 65% HNO_3 was added, and then shaken carefully until the ashes mixed with the acid before it was put on the hot plate again with 100°C temperature and dried up. And then the ashing process repeated again, but this time the temperature only maintained for 3 hours. After the ashes have perfect white color, it was then let cooling down, then 5ml of 6M HCl was added in each sample before they are shaken carefully. Then they were put back on the hot plate on 100°C temperature until they were dried up. After that, added 10 ml of 0.1M HNO_3 to the sample and were let cooling down in room temperature for an hour, before the sample were put in 50 ml polypropylene flask and 0.1M HNO_3 were added as matrix modifier solution, which was poured until it reached the marking. Lead standard solution were then prepared in minimum 5 concentration point. The standard solution, sample and spiked were read in graphite furnace atomic absorption spectroscopy (GFAAS) on the wave length of 288.3 nm for lead. The concentration of lead can be calculated using the formula (SNI 2354.5:2011):

$$\text{Concentration} = \frac{(D - E) \times Fp \times V}{W}$$

Legend:

D : µg/l sample concentration from AAS readings
E : µg/l blank solution concentration from AAS readings
Fp : dilution factor
V : final volume of prepared sample solution (ml), converted into liter
W : weight of sample (g)

The result of lead measurement of innards and muscle tissues were analyzed by using quantitative descriptive analysis.

RESULTS

The result of lead measurement of innards (liver, kidney, and lung) and muscle tissues can be seen in Table 1.

From the measurement can be seen that the average level in the liver, kidney, and lung are higher than in the muscle tissues. From the innards, the lung has the highest level of contamination (1.1064 ± 0.08), and the liver has the lowest (0.7576 ± 0.25). But the level are still under the maximum of SNI-7387-2009 recommendation, which is 2.00 ppm.[7]

Table 1 **Lead measurement of Bali cattle's innards (liver, kidney, and lung) and muscle tissues, which were raised in Suwung Landfill**

No	Liver	Kidney	Lung	Muscle Tissues
1	0.6918	0.5829	1.1335	0.6818
2	0.4495	1.0504	1.0705	0.7015
3	1.1396	1.1306	1.1966	0.6774
4	0.7570	0.9213	1.1400	0.7120
5	0.7600	0.9012	0.9914	0.6993
Ave-rage	0.7576 ± 0.25	0.9173 ± 0.21	1.1064 ± 0.08	0.6944 ± 0.13

DISCUSSION

Higher lead content in the innards shows that eating those can cause high risk of health hazard for the consumer. The risk of consuming innards of a cattle now are not only cholesterol, but also lead contamination. Lead-contaminated innards and meat have very high chance to come from cattle raised in a bad environment, especially a landfill. Heavy metal lead in a cattle's body are distributed on various tissues including innards, based on the level of serum glutamate oxalate transaminase (SGOT) enzyme.[2] Lung has the highest content of lead (1.1064 ± 0.08 ppm), followed by kidney (0.9173 ± 0.21 ppm), liver (0.7576 ± 0.25 ppm) and the muscle tissues (0.6944 ± 0.13 ppm). The lung is an organ that has the most blood vessel, so it has very high potential to be exposed to lead if lead content level in the blood is high. Histopathology

picture of a lung with high exposure to lead can show that there are inflammation, emphysema, and pulmonary edema.[4] If the lead content level reaches toxicity, various organs will show a dysfunction reaction, especially in liver, kidney and central nervous system because of oxidative stress.[8]

Liver as a detoxification organ, in this study shows lower lead content level compared to the lung. This result is different from a study that reported that the liver and kidney have the highest lead content level in Nigeria, either in cow, chicken, and also lamb.[9] A study in fishes also reported that the liver has the highest lead content level, followed by kidney, gill and muscle tissues.[9] The cause of this difference is not well-known yet, and needs to be further studied. Even so, there is a similarity in the reports, which is the low lead content rate in the muscle tissues. This shows that the muscle tissues have more resistance against lead contamination. A study on ducks also reported that the muscle tissues have the highest resistance against lead exposure.[10] Thus beef consumer can be assured that consuming the meat is safer than the innards, even when the lead content level is still below the maximum recommended by SNI-7387-2009, which is 2.00 ppm.[7]

There are numerous products made from Bali cattle such as lung crackers, liver crackers, and many more which are sold in supermarket or even traditional market. If the product is made from a lead-contaminated Bali cattle, the product will not be safe to consume. To give a sense of safety to the consumer, there is a need to regulate and control Bali cattle products. From the raising environment of the cattle, canning process, until it reach the marketplace. So examination of lead content in each step is very important. Also it was found that there were lead contamination in canned pork.[11] This shows the importance of lead examination in every stage of meat processing before they reach the consumer.

CONCLUSION

In a lead-contaminated cattle, the innards parts contain more lead compared to the muscle (meat) parts. That means the consumer are safer to choose the meat part compared to the innards.

SUGGESTION

There is a need to examine the meat for lead contamination in all stages of meat processing, and also from where the cattle is grazing.

REFERENCES

1. Jaishankar, M. et al., 2014. Toxicity, mechanism and health effects of some heavy metals. *Interdisciplinary Toxicology*, 7(2), pp.60–72. Available at: http://www.degruyter.com/view/j/intox.2014.7.issue-2/intox-2014-0009/intox-2014-0009.xml
2. Berata, I K. Susari, N.N.W. Kardena, I M. 2015. Deteksi Logam Berat Pb dan Cd, dan Hubungannya dengan SGPT/SGOT darah Sapi Bali yang Dipelihara di TPA Suwung Kota Denpasar. Prosiding ISBN 9786022940913. Seminar Nasional Sains dan Teknologi II 2015. Kuta 29-30 Oktober 2015. 1214-18.
3. Brochin, R., Leone, S, Phillips, D., Shepard, N., Zisa, D. & Angerio, A, 2008. The Cellular Effect of Lead Poisoning and Its Clinical Picture. The Georgetown Undergraduate Journal of Health Sciences 5(2) 1-8.
4. Snejana, P., 2010. the Consequences of Chronic Exposure To Lead on Liver , Spleen , Lungs and Kidney Arhitectonics in Rats. , XLIII(2), pp.123–7.
5. Lamondo, D. et al., 2014. Antioxidant effects of Sarang Semut (Myrmecodia pendans) on the apoptosis of spermatogenic cells of rats exposed to plumbum. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, 5(4), pp.282–94.
6. Miller, T.E. et al., 1998. Developmental exposure to lead causes persistent immunotoxicity in Fischer 344 rats. *Toxicological Sciences*, 42, pp.129–35.
7. Badan Standardisasi Nasional (BSN). 2009. Standar Nasional Indonesia (SNI) 7387-2009 tentang Batas Maksimum Cemaran Logam Berat dalam Pangan. 1-25.
8. Sharma, B., Singh, S. & Siddiqi, N.J., 2014. Biomedical implications of heavy metals induced imbalances in redox systems. *BioMed Research International*, 2014.
9. Akan, J.C. et al., 2010. Distribution of heavy metals in the liver, kidney and meat of beef, mutton, caprine and chicken from Kasuwan Shanu Market in Maiduguri Metropolis, Borno State, Nigeria. *Research Journal of Applied Sciences, Engineering and Technology*, 2(8), pp.743–8.
10. Ferreyra, H. et al., 2015. Lead exposure affects health indices in free-ranging ducks in Argentina. *Ecotoxicology*, 24(4), pp.735–45.
11. Santhi, D. Blakrishnan, V. Kalaikannan A. Radakrishnan KT. 2008. Presence of Heavy Metal in Pork Product Chennai (India). American Journal of Food Technology 3(3): 192-9.