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Technology on Biosciences and Social

“Industry based on Knowledges”

17th-19th November 2016, Convention Hall, Andalas University

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Animal Science Faculty of Andalas University
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Organized by:

Animal Science Faculty of Andalas University
and
Alumbi Center of Universiti Putra Malaysia

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Investigation of Cadmium Contamination in Mealworm, Ration and Broilers' Feces

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Abstract

Mealworm (*Tenebrio molitor L*) is a beetle larva that can be used as a source of protein a substitute for MBM. Cadmium is one of heavy metals that disturb metabolic process leading to toxicity to the broiler. As far as the feed ingredients is an integral part of the consumer's food chain, it's need to be assessed as potential sources of Cd contamination. However, a study about utilization mealworm in broilers feed formulations has been done yet in the point of viewed of food safety, especially Cadmium (Cd) free. The objective of this research was to investigate the contamination levels of cadmium in mealworm, ration and broiler's feces. A total 200 DOC (Lohman strain) placed in 20 plots divided into two treatments, T0 was broilers fed with 0% mealworm concentrate, 5% MBM and T1 was 5% mealworm concentrate, 0% MBM. The Cd contamination in the mealworm, ration (T0 and T1), and broiler's feces were analyzed using ICP-OES instrument method. The result showed that no Cd contamination were detected in the mealworm, ration and broiler's feces from both treatments. It could be conclude that the mealworm is a safe ingredient for feed.

Keywords: mealworm, cadmium, broilers, ration, feces

1. Introduction

Feed is one of the factors that having an important role in the raising of broilers. A qualified feed has a complete composition of substances, such as proteins. Especially the protein source derived from animal are commonly used in poultry feed mixture in many countries such as *Meat and bone meal* (MBM), this is used as a source of amino acids, calcium (Ca) and phosphorus (P) [1]. Until now, Indonesia, still importing about 100% of MBM from Australia, New Zealand and America. The Efforts to overcome the issue was using feed based raw materials local a substitute for mbm are insects (mealworm).

The mealworm with latin name's *Tenebrio molitor L*, is the larva of the beetle rice [2]. Mealworms can be used as a substitute protein source MBM, because it is local feed ingredients, high nutrient density, easily maintained, high production, and environmentally friendly. However, no studies using mealworms as a substitute of MBM in broiler feed formulations in the point of viewed of food safety. Before being introduced as a new raw material for animal feed, it's need to do further research on food security because the insect was suspected containing harmful chemicals. Some of these chemicals can be present in the substrate of

insects, especially heavy metals, namely cadmium.

Reference [3] shows cadmium is the most toxic among other heavy metals in the water and soil. Total production of cadmium in the worldwide is estimated about 22,300 tons according to the British Geological Survey in 2010. Cadmium is heavy metal toxic highly dangerous for human and other mammals. Cadmium contamination is from the air, soil, water and smoke. After food contaminated cadmium be in the body, it can be accumulated in several organs and tissues, including in the liver and kidneys [4]. The exposure of cadmium caused harmful effects on health, including renal dysfunction, heart disease, hypertension, osteoporosis, liver toxicity, changes in the activity of the pancreas and cancer [5]. Cadmium was classified as carcinogenic material to humans and animals [6]. Itai-itai disease is a bone disease caused by chronic cadmium poisoning, this occurred in Japan in the food and water supply industry in the river Jinzu [7].

Previous studies showed that products derived from animals, food and feed products derived from insects were suspected having hazardous chemicals, by environmental contaminants, for instance heavy metals [8]. According to [10], in the mealworm (*T. molitor*) was found cadmium (Cd) that were maintained in several different soil characteristics. In agreement to [9] that insects can accumulate cadmium. Investigation of cadmium level in the mealworm would be very importance, since mealworm is local ingredient that substitute MBM with high protein content. Therefore, the objective of this study was investigating Cd contamination in mealworms, broiler's rations containing flour mealworm and feces of broiler that was fed with ration containing flour mealworm.

2. Material and Methods

2.1. Treatments

A total of 200 DOC (*Day Old Chick*) MB 202 Platinum (*Lohman strain*) from PT JAPFA Comfeed Indonesia Tbk were raised in the cages until 35 days old, then its was moved into the individual cage until 38 days old. All the broilers were divided into two treatments and 10 replications. T0: mealworm ration containing 0%, 5% MBM (control), R1: mealworm ration containing 5%, 0% MBM. Ration and drink were given by ad libitum.

2.2 Sample collection

The mealworms aged 2-4 month were obtained from several large farmers in Indonesia, such as Malang, Bekasi and Bogor. All samples were mixed into a composite sample, then mealworms were processed into mealworm concentrate, and then were formulated with other feed such as corn, soybean meal, rice bran, palm oil, limestone, salt, DL-Methionin 99%, DCP (P18%) to be ration T1, as well as additional rations T0 with MBM and other feed. Samples of ration were taken after the process of formulating finisher ration.

2.3 Analysis of Samples

Cadmium contamination in all samples (2-4 month of) were measured according to [11]. In Brief, [11] explained that the samples were processed in HNO₃ to detect Cadmium and were analyzed using *inductively coupled plasma optical spectrometry* (ICP OES, Agilent type CCD detector 720, USA). As much as 0.5 ml sample were added 10 ml HNO₃, destruction for 15 minutes at temperature of 150⁰ C. After that samples were put into the 40 ml flask and diluted with aquadest and filtered. Analysis was conducted using *inductively coupled plasma optical spectrometry* (ICP OES) with a wavelength of 214 439 nm cadmium. Calibration curve was analyzed to calculate the levels of cadmium contamination. All of analysis was carried out by duplo.

2.4 Data Analysis

Cadmium contamination in mealworm, mealworm concentrate, ration and feces were observed. If any contamination was found in the feces, then proceed to the analysis of the liver and kidneys contamination. The data was analysis using descriptive method by comparing Cd levels in the mealworm, ration and feces with the applicable standards.

3. Result and Discussion

3.1 Cadmium contamination in mealworm

The analysis of mealworms that were obtained from several regions showed no cadmium contamination was detected. Reference [9] shows maximum limit of cadmium metals in the feed material derived from animal is 2 mg/kg or 2 ppm (88% dry matter). In general, farmers in Indonesia maintains mealworm intensively, in a box plywood boards are arranged in a closed room, with the provision of feed substrate is maintained such as pollard and bran. This evidence showed the source of feed, mealworms environment is also not detected cadmium.

Demand [12] stated there are a few studies explore about the absorbed mechanism of metal in terrestrial invertebrates, and this study mostly done on earthworm. Heavy metal contamination on a mealworm through consumption of contaminated food [10]. Its is different from the earthworm, metal contaminants enter the body through the skin. This is because the mealworm has the cuticle layer of wax that serves to avoid water loss, so that the metal contamination does not easily go in through the body, but the food, in contrast to earthworms that have skin that can be penetrated by water and metal contamination [10]. Reference [13] shows found that the larvae of the mealworm able to control contamination of cadmium in the body when exposed to metal contamination through the feed. They also found that most of the accumulation of cadmium may be removed

during metamorphosis. Reference [14] shows that cadmium can form a soluble inorganic lipid compound that can easily pass through microvilli of the gastrointestinal tract of animals, in which the walls of the gastrointestinal tract is the main organ for the stack of metal contamination.

3.2 Cadmium contamination in the ration

Table 1 showed that contamination level of Cd in all samples. All of samples were detected have no contamination of Cd. Reference [15] shows limit of cadmium in the diet about 0.5 ppm according to EU standards. The concentration of cadmium in food is influenced by food type and geographic region. Cadmium can be obtained from plants and animals [7]. Cadmium with low concentrations is not toxic, but when accumulated to a certain degree can be toxic to animals or humans pass through the food chain [16]. According to the FAO or WHO, consumption of Cd per week which is tolerable for humans is 400-500 ug/person or 7ug/kg of body weight (0,007 ppm) [17]. Meanwhile, that cadmium toxicity lethal at a dose of 225 ppm consumption, with a tolerable weekly intake is 0.007 ppm weight (*provisional tolerable weekly intake / PTWI*) [18].

3.3 Cadmium contamination in the feces

In table 1 the T0 and T1 treatment there are no cadmium contamination. T0 and T1 in-

Tabel 1. Cadmium Contents Ration and Feces

	T0	T1	Limit of Detection ICP-OES (ppm)	Literature
Ration	Nd	Nd	0.00011	0,5 ppm [15]
Feces	Nd	Nd	0.00011	Cd contents in animal feeds: 0,851 ppm, Cd contents in manure: 1,281 ppm [11]

Information: Nd= Not detected

indicated that the rations, feces water and a safe environment from cadmium. No detection of cadmium states that the study was conducted in a good environment. Reference [11] shows states that the average cadmium contamination in livestock rations 0.851 ppm, and the manure became 1.281 ppm, the addition of supplements allegedly occurred outside the ration and environmental factors close to traffic and industrial pollution.

Conclusion

This result showed that no Cd contamination were detected in the mealworm, ration and broiler's feces from both treatments. So, it could be conclude that the mealworm is a safe ingredient for broiler feed and could be utilize as a substitute of MBM.

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