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The effect of protein levels in rations on the percentage of internal organs of Local Bali pigs

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Abstract

Feed quality is one of the factors that affect internal organs. The purpose of this study is to determine the effect of protein levels in the rations on the percentage of internal organs of local bali pigs. The experimental design used was a completely randomized design (CRD) consisting of 4 treatments and 4 replications. The four treatments are: P1 (ration with 14% protein level), P2 (ration with 16% protein level), P3 (ration with 18% protein level) and P4 (ration with 20% protein level). The observed variables include: percentage of heart, lung, liver, kidney, stomach, small intestine, and large intestine. The results showed that the administration of protein levels from 14% to 16%, 18% and 20% led to an increase in the percentage of local bali pig stomachs by 9.80%, 5.88%, and 13.72% respectively, while the percentages of heart, lung, liver, kidney, small intestine, and large intestine were the same among the treatments. It can be concluded that the provision of rations with a protein level of 14%; 16% 18%; and 20% can increase the percentage of the local bali pig stomach, but it does not affect the percentage of the heart, lungs, liver, kidneys, small intestine, and large intestine.

Keywords: Local Bali Pigs; Internal Organs; Protein Level; Rations

1. Introduction

Pig farming in Bali has an important role, especially in the context of the habits and customs of the Balinese people. According to [3], one of the customs of the people in Bali is to use pigs as pigs both in religious ritual ceremonies and sold as culinary commodities. The disadvantage of local bali pigs is that their growth is slower compared to imported breed pigs [4]. One of the efforts to increase the productivity of local bali pigs is to raise local bali pigs intensively and provide quality rations.

Rations are a combination of various feed ingredients that are specially formulated to meet the daily needs of livestock without disturbing their health. Rations are considered to be of good quality if they are able to provide all the nutritional needs of livestock appropriately, both in type, quantity, and nutritional balance. According to [16], local bali pigs fed rations with an ME/CP balance of 2800 kcal/16% had the best feed efficiency, while the ME/CP balance of 2950 kcal/18% gave the highest body weight gain. Furthermore, [6] stated that supplementation with a mixture of lysine, methionine, and choline in the ration of male bali pigs with levels of 0.5% and 1% was able to affect the percentage of weight of the lungs, liver, pancreas, stomach, and small intestine.

Good feed quality will help the internal organs to work lighter in breaking down and absorbing nutrients for the growth process of livestock. According to [9], internal organs are all parts of the body contained in the chest cavity and abdominal cavity which include the heart, lungs, liver, kidneys, spleen, bile, and digestive tract (stomach, small intestine, colon). In addition to playing a role in the digestion process and metabolism of nutrients, internal organs also have a fairly high economic value because they can be processed into various types of dishes, especially fried foods.

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Based on this information, further research is needed to determine the right level of protein in the ration related to the percentage of internal organs of local bali pigs because the health of internal organs is very important in the process of digestion and metabolism of food substances necessary for livestock productivity.

2. Materials and Methods

2.1. Material

A total of 16 heads local bali pigs (unsexing) were kept in 16 individual cages, with a length of 1.2 m, a width of 0.6 m, and a height of 0.75 m. The cage is made of iron as a partition and the floor is made of concrete. The rations given in this study were conventional rations with different protein levels, namely 14%, 16%, 18%, and 20%. Rations are given twice a day, namely in the morning and evening. The nutrient content in the ration are shown in Table 1.

Table 1 Nutrient content in rations

Nutrient	**Treatment[1)]**			
	P1	P2	P3	P4
Metabolism Energy (kkal/kg)	2893	2898	2899	2898
Crude Protein (%)	14.01	16.05	17.66	19.60
Crude Fiber (%)	6.77	6.81	7.00	7.20
Calcium (%)	0.51	0.79	1.06	1.34

Note:Treatment: P1: Rations with a protein level of 14%; P2: Ration with a protein level of 16%; P3: Ration with a protein level of 18% and P4: Ration with a protein level of 20%

2.2. Methods

This study was carried out for 12 weeks using a complete randomized design (CRD) consisting of 4 treatments and 4 replications, each replication consisted of one head local bali pigs. The four treatments are: P1 (ration with a protein level of 14%), P2 (ration with a protein level of 16%), P3 (ration with a protein level of 18%) and P4 (ration with a protein level of 20%).

2.2.1. Slaughter procedure and collection of internal organ data

Slaughter of pigs is carried out after 12 weeks of rearing. Before being slaughtered, the pig is fasted for 12 hours, while drinking water is still given. This aims to empty the contents of the digestive tract so that what is weighed is purely the weight of the body. Next, the pig is stunned with an electric current at the back of the ear with a clamp that is passed through an electric current. The slaughter process is carried out by stabbing a knife at the front end of the sternum (*Manubrium sterni*) in the ventral part, so that it can cut the carotis artery, jugularic vein, and cranial vena cava to effectively bleed [8]. The next stage is the cleaning of the fur and the removal of internal organs. The internal organs are then separated one by one, including: heart, liver, lungs, kidneys, stomach, small intestine, and large intestine then weighed using a digital scale. Stomach, small intestine and large intestine weighed in an empty state.

Observed Variables

The variables observed in this study are the internal organs, including: the percentage of heart, liver, lungs, kidneys, stomach, small intestine, and large intestine. Each of these variables is calculated using the following formula:

$$\text{Heart percentage (\%)} = \frac{\text{Heart weight}}{Slaughter\ weight} \text{ x } 100\ \%$$

$$\text{Lung percentage (\%)} = \frac{Lung\ weight}{Slaughter\ weight} \text{ x } 100\ \%$$

$$\text{Liver percentage (\%)} = \frac{\text{Liver weight}}{Slaughter\ weight} \text{ x } 100\ \%$$

$$\text{Percentage of kidneys (\%)} = \frac{Kidneys\ weight}{Slaughter\ weight} \text{ x } 100\ \%$$

$$\text{Stomach percentage (\%)} = \frac{\text{Stomach weight}}{Slaugter\ weight} \text{ x } 100\ \%$$

$$\text{Small intestine percentage (\%)} = \frac{Small\ intestine\ weight}{Slaughter\ weight} \text{ x } 100\ \%$$

$$\text{Large intestine percentage (\%)} = \frac{Large\ intestine}{Slaughter\ weight} \text{ x } 100\ \%$$

3. Results and discussion

Data from the study on the effect of feeding with protein levels of 14% (P1), 16% (P2), 18% (P3), and 20% (P4) on the percentage of internal organs of local bali pigs (heart, lungs, liver, kidneys, stomach, small intestine, and large intestine) are shown in Table 2.

Table 2 Percentage of internal organs of a local bali pigs fed ration with different protein levels

Variable	Treatment[1)]				SEM[3)]
	P1	P2	P3	P4	
Slaughter weight (gr)*)	42.59[a]	45.36[b]	44.33[a]	41.97[a]	0.77
Heart percentage (%)	0.45[a3)]	0.43[a]	0.37[a]	0.39[a]	0.02
Lung percentage (%)	1.03[a]	0.75[a]	0.80[a]	1.02[a]	0.09
Liver percentage (%)	2.34[a]	2.29[a]	2.32[a]	2.58[a]	0.09
Kidney percentage (%)	0.51[a]	0.47[a]	0.46[a]	0.49[a]	0.01
Stomach percentage (%)	1.02[b]	1.12[a]	1.08[ab]	1.16[a2)]	0.02
Small intestine percentage (%)	2.10[a]	2.15[a]	2.20[a]	2.31[a]	0.75
Large intestine percentage (%)	2.42[a]	2.77[a]	2.34[a]	2.88[a]	0.18

Note: Treatment: P1: Rations with a protein level of 14%; P2: Ration with a protein level of 16%; P3: Ration with a protein level of 18% and P4: Ration with a protein level of 20%; Values with different letters on the same line show a significant difference (P<0.05); SEM: Standard Error of the Treatment Means; *) Suputra (un-published)

The heart percentage of local bali pigs in this study ranged from 0.37-0.45% (Table 2), with the highest value in the P1 treatment of 0.45%, followed by P2 (0.43%), P3 (0.37%) and P4 (0.39%). This value is still relatively normal because according to [12], the percentage of heart weight ranges from 0.42-0.75% of live weight. The heart is a vital organ that functions in the blood circulation and is very susceptible to toxins and antinutrients because it can cause excessive contractions.The results of this study are almost the same as those reported by [1], that the heart percentage of male pig fed a ration with a protein level of 14-18% ranges from 0.32-0.52%; but lower than [6] which stated that the percentage of heart of male local bali pigs fed rations with a mixture of lysine, methionine, and choline of 1% ranged from 0.50-0.52% of their body weight. The statistical analysis showed that the feeding of rations with a protein level of 14-20% did not significantly effect (P>0.05) on the heart percentage of local bali pig, but the value tended to decrease with the increase of the protein level given. These results reflect that rationing with a protein level of 14-20% has not caused excessive contractions so the percentage is still normal and the same among all treatments. The results of this study were supported by [1], that the percentage of pig hearts that were rationed with protein levels of 14%, 16% and 18% decreased from 0.52% to 0.43% and 0.32%. The decrease is directly proportional/in line with the increase in life weight.

The percentage of lungs in the results of this study ranged from 0.75-1.03% with the highest value in the P1 treatment which was 1.03% (Table 2), while in the P2, P3 and P4 treatments it was lower than P1 respectively by 27.18%; 22,33%; 0.97%, but statistically not significant difference (P>0.05). These results reflect that feeding with a protein level of 14-20% does not affect on the lungs work so the percentage is almost the same among all treatments. The percentage of lungs that tend to decrease is influenced by their increasing body weight. The results of this study are in accordance with [1] that the percentage of male pig lungs fed rations with protein levels of 14%, 16% and 18% decreased from 0.94% to 0.79% and 0.75%. The percentage of lungs in the results of this study is also almost the same as [6] who reported that the percentage of lungs of male local bali pigs fed rations with a mixture of lysine, methionine, and choline with a level of 1% ranged from 0.77-0.94%. The lungs are organs in the respiratory system related to the circulatory

system that function to exchange oxygen from the air with carbon dioxide from the blood. The percentage of lungs is influenced by various factors, namely: race, age, and the composition of the feed consumed [15].

The percentage of liver in the results of this study ranged from 2.29-2.58% with the highest value in the P4 treatment (20% protein level) which was 2.58% (Table 2), while in the P1 treatment (14% protein level), P2 (16% protein level), and P3 (18% protein level) the values were lower at 9.30%, 11.24%, and 10.07% respectively, but statistically not significant difference (P>0.05). This reflects that there are no signs of abnormalities or toxicity in the liver that can be associated with the treatment given. The liver is the largest organ in the body which has several functions, including: secreting bile, metabolizing carbohydrates, proteins, fats, detoxifying toxic compounds and excreting metabolite compounds that are no longer useful for the body, storing several vitamins, destroying red blood cells, and forming blood proteins [11]. According to [14], the increase in liver weight occurs due to exposure to diseases or toxins that are included in food intake. When toxic substances are consumed in higher amounts, the liver has to work harder to produce and excrete bile to cope with the toxins. As a result, the size of the liver becomes larger. The results of this study are almost the same as [6] which stated that the percentage of male bali pig liver fed rations with mixed supplementation. Lysine, methionine, and choline with a level of 1% ranged from 2.26-2.82%. However, the results of this study were higher than [5] which stated that the percentage of male bali pig liver given rations with the supplementation of amino acids lysine 0.75%, methionine 0.20% and tryptophan 0.07% ranged from 1.90-2.28% of the slaughter weight. Furthermore, [1] reported that the percentage of pig liver rationed with protein levels of 14%, 16% and 18% respectively was 2.05%; 1.97% and 1.95% or ranging from 1.95-2.05%.

The percentage of kidneys in this study ranged from 0.46-0.51% with the highest value in the P1 treatment (0.51%), while in the P2, P3 and P4 treatments the value was lower than P1 respectively by 7.84%; 9.80% and 3.92%, but statistically no significant difference (P>0.05). The results of this study reflect that the provision of protein up to the level of 20% in the pig ration has not had a negative impact on kidney work so the percentage is almost the same. The results of this study are in line with [7] who stated that the percentage of local bali pig kidneys that received rations plus turmeric extract (*Curcuminoid*) 0.06 ml/1 kg of body weight was 0.47% of their body weight. The percentage of kidneys in this study was higher than that of [1] who reported that the percentage of kidneys of male pigs fed rations with a protein level of 14% was 0.35% while the 16% and 18% were 0.31% and 0.28% respectively (ranging from 0.28-0.35%). The kidneys are internal organs that have an important role in excretory function, water and electrolyte balance, and endocrine. Overall kidney function is based on nephron function and impaired kidney function is caused by decreased nephron function [17]

The percentage of stomach in the results of this study ranged from 1.02% - 1.16% (Table 2). Feeding with protein levels of 14% (P1), 16% (P2), 18% (P3) and 20% (P4) led to a significant increase in stomach percentage by 9.80%; 5.88% and 13.72% respectively compared to P1. These results reflect that an increase in protein levels in a ration with the same energy level leads to an increase in stomach percentage. This is due to the higher crude fiber content in the ration (Table 1) so that the size of the stomach is larger because the feed is bulky and has an impact on the weight of the stomach is getting higher. This opinion is supported by [10] who stated that increasing the provision of rations containing high fiber will increase gastric capacity which affects gastric weight gain. The results of this study are in line with [6] which stated that the percentage of stomach weight of male local bali pigs fed rations with a mixture of lysine, methionine, and choline supplementation with a level of 1% is 1.13% of their body weight.

The average percentage of small intestine in this study ranged from 2.10-2.31% (Table 2) with the highest value in the P4 treatment (2.31%), followed by P3 (2.20%), P2 (2.15%) and P1 (2.10%), but statistically not significant difference (P>0.05). The results of this study reflect that the protein level of 14-20% in the ration has not had a significant influence on the work of the small intestine, although the value tends to increase. The value that tends to increase is suspected to be due to the increasing crude fiber in the ration (Table 1) so that the intestines are heavier and longer so that the weight and percentage are higher. The results of this study are in accordance with [2] that the percentage of small intestine weight is influenced by the nutrients contained in the ration, especially the protein content which is quite high. The percentage of small intestine in this study is smaller than reported by [6] that the small intestine percentage of male local bali pigs is 2.90% of their body weight and [1] reported that the small intestine percentage of male pigs (in an empty state) fed with a protein level of 14-18% ranged from 1.22-2.03%.

The percentage of large intestine in this study ranged from 2.42-2.88% (Table 2) with the highest value in the P4 treatment of 2.88%, followed by P2 (2.77%), P1 (2.42%) and P3 (2.34%), but statistically was not significant difference (P>0.05). These results showed that feeding with a protein level of 14-20% did not have a significant effect on large intestine function, although the percentage tended to increase. This is suspected to be due to a higher crude fiber content than P1 (Table 1). This is in line with what was conveyed by [10] that the length and weight of the intestine are affected by the presence of crude fibers. The large intestine have an important role in the fermentation of fiber at the end of the

digestive tract. An increase in the capacity of the large intestine causes an increase in the weight of the large intestine of pigs. [13] states that the large intestine consists of three parts, namely: colon, cecum, and rectum. The overall length can reach 7.5 m with a volume capacity of 26 liters, the length of the large intestine depends on age, body weight and the type of food obtained. The percentage of large intestine in this study was greater than [6] which stated that supplementation with a mixture of lysine, methionine, and choline in the ration with a level of 1% obtained a percentage of the large intestine weight of a male local bali pig of 2.44% of its body weight. Furthermore [1] reported that the percentage of the large intestine of a male pig (in an empty state) fed a ration with a protein level of 14-18% ranged from 1.41-1.82%.

4. Conclusion

Based on the results of this study, it can be concluded that the provision of rations with a protein level of 14%; 16% 18%; and 20% can increase the percentage of the stomach of the local bali pig, but it does not affect the percentage of the heart, lungs, liver, kidneys, small intestine, and large intestine.

Compliance with ethical standards

Disclosure of conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript

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