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(RESEARCH ARTICLE)

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Enhancement of carcass physical characteristics of male Bali pigs during the starter–grower phase through dietary supplementation of essential amino acids and choline

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Abstract

This study was conducted with the aim of knowing the effect of supplementation of a mixture of essential amino acids (lysine. methionine and tryptophan) and choline in standard feed in Bali pigs reared in starter (1 month) and grower (2 months) phases. The design used in this study was a completely randomized design (CRD) with four treatments and each treatment had 4 replications. so in this study 4 x 4 tails = 16 weaned male Bali pigs were used. The treatments that were tested on weaning Bali pigs were feed treatment which consisted of: treatment P0 : standard feed; P1 : Feed P0 + 0.50% mixture of essential amino acids (lysine. methionine and tryptophan) and choline; P2: feed P0 + 1% mixture of essential amino acids (lysine. methionine and tryptophan) and choline; and P3: feed P0 + 1.5% mixture of essential amino acids (lysine. methionine and tryptophan) and choline. In the starter phase fed CP 551 (for 1 month) and in the grower phase fed CP 552 (for 2 months). Observation data included slaughter weight, carcass weight. Carcass percentage, meat percentage. fat percentage and bone percentage. The results of the study found that the addition of a mixture of essential amino acids (lysine, methionine, tryptophan) and choline in the ration had a significant effect ($P<0.05$) on slaughter weight, carcass weight, physical composition of Balinese pig carcasses (meat and fat), but had no significant effect ($P>0.05$) on the physical composition of carcass bones.

Keywords: Bali Pig; Essential Amino Acids; Carcass Weight; Physical Carcass Properties

1 Introduction

Balinese pigs are a local genetic resource that plays a vital role in traditional livestock systems in Indonesia. particularly in Bali. Their superiority lies in their high adaptability to local environments. but their production performance. particularly carcass quality. remains relatively low compared to commercial breeds. Therefore. nutritional innovations are needed to improve production efficiency and carcass quality without compromising their adaptive advantages.

Carcass quality is a crucial parameter in determining the economic value of pigs. including carcass weight. carcass percentage. and backfat thickness. The primary factor influencing carcass quality is feed management. particularly the balance of essential nutrients such as protein and amino acids. Essential amino acids such as lysine. methionine. and tryptophan are known to play a crucial role in protein synthesis. muscle tissue growth. and feed conversion efficiency. A deficiency of essential amino acids in the ration. which is common in plant-based feeds. can inhibit growth and reduce pig production performance.

Besides amino acids. choline is an essential nutrient that plays a role in fat metabolism. cell membrane formation. and liver function. The combination of essential amino acids and choline supplementation in feed has been reported to improve growth performance. feed efficiency. and physiological development of livestock. Previous research has shown that the addition of a mixture of essential amino acids and choline to traditional feed can increase final body weight.

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body weight gain. and feed utilization efficiency in male Bali pigs. Furthermore. this supplementation has also been shown to significantly impact physiological organ development. indicating an improvement in the livestock's metabolic status [1].

Although various studies have examined the effects of amino acid and choline supplementation on growth and reproductive performance. studies specifically linking such supplementation to improvements in the physical characteristics of male Bali pig carcasses during the starter-grower phase are limited. This is despite the fact that the starter-grower phase is a critical period in determining growth potential and body tissue composition. which directly impact carcass quality in subsequent phases [2].

Based on this. this study is crucial to evaluate the effect of innovative supplementation of essential amino acids and choline in feed on improving the physical characteristics of male Bali pig carcasses during the starter-grower phase. The results are expected to contribute scientifically to the development of sustainable. locally resource-based nutritional strategies and to increase the economic value of Bali pigs.

2 Material and methods

2.1 Animal

This research was The study will use 16 weaned male Bali pigs with an average body weight of 10–11 kg. The weaned male Bali pigs were purchased from a Balinese pig collector in Gerokgak Village. Buleleng Regency (Bali).

2.2 Feed and Drinking Water

The feed ingredients for experimental pigs consist of: yellow corn. 152% concentrate. wheat bran or pollard. lysine. methionine. tryptophan. choline. table salt. and minerals. The pig feed (ration) formulation is as follows:

2.2.1 Starter Feed ME/CP ratio = 3000kcal/kg/20 %. given for 4 weeks.

- P0: Starter feed.
- P1: P0 feed + 0.50% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline.
- P2: P0 feed + 1% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline.
- P3: P0 feed + 1.5% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline [3].

2.2.2 Grower feed ME/CP ratio = 2800 kcal/kg/16% given for 8 weeks.

- P0: Grower feed.
- P1: P0 feed + 0.50% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline.
- P2: P0 feed + 1% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline.
- P3: P0 feed + 1.5% mixture of essential amino acids (lysine. methionine. and tryptophan) and choline.

2.3 Observed Variables

The data observed in this study include: slaughter weight. carcass weight. carcass percentage. carcass physical composition (percentage weight of bone. meat and fat).

2.4 Slaughter Weight

Slaughter weight was obtained by measuring the body weight of Balinese pigs in each treatment unit (16 animals) before the pigs were slaughtered [4].

2.5 Carcass Weight

Carcass weight is the weight of the animal's body after cutting and removing non-carcass parts. namely: blood. digestive tract. distal legs. internal organs (offal) and fur.

2.6 Carcass Percentage

The carcass percentage is obtained by dividing the carcass weight by the slaughter weight of Balinese pigs. then multiplying by 100 percent.

2.7 Carcass physical composition

The physical composition of the carcass is obtained by separating the bone. meat. and fat components from the carcass. The percentage of the physical composition of the carcass is obtained by dividing the weight of the physical composition of the carcass (bone. meat. and fat) by the weight of the carcass and then multiplying by 100 percent.

2.8 Research Design

The design used in this research was a completely randomized design (CRD) with four treatments and each treatment had 4 replications. so this research used 4 x 4 heads = 16 weaned male Bali pigs

3 Results and discussion

Research data on carcasses and the physical composition of Balinese pig carcasses supplemented with a mixture of lysine. methionine and tryptophan in feed are presented in Table 1.

Table 1 Carcass and physical composition of Balinese pig carcasses supplemented with a mixture of Lysine, methionine and Tryptophan in feed

Variable	P0	Treatment (1) P1	P2	P3	SEM(3)
Slaughter weight (kg)	34.6a (2)	37.5b	39c	42d	0.28
Carcass weight (kg)	22.36a	24.32b	25.49c	27.68d	0.51
Carcass percentage (%)	64.63a	64.87a	65.35a	65.91a	0.38
Percentage meat (%)	41.71a	44.17ab	43.77ab	45.70b	0.72
Fat percentage (%)	40.52a	40.04ab	38.89b	36.37c	0.34
Bone percentage (%)	17.7a	17.45a	17.5a	17.58a	0.11

Description: 1. Feed Treatment; P0: Commercial feed (CP 551 for the starter phase and CP 552 for the grower phase).;P1: P0 + 5% of the required mixture of lysine, methionine, tryptophan, and choline.;P2: P0 + 10% of the required mixture of lysine, methionine, tryptophan, and choline.;P3: P0 + 15% of the required mixture of lysine, methionine, tryptophan, and choline.;2. Values with different letters in the same row are significantly different (P<0.05).; 3. SEM: Standard Error of the Treatment Mean

Based on the research results (Table 1), the addition of a mixture of essential amino acids (lysine, methionine, tryptophan) and choline in the ration had a significant effect (P<0.05) on slaughter weight, carcass weight, and the physical composition of Balinese pig carcasses.

Slaughter weight increased significantly from treatment P0 (34.6 kg) to P3 (42 kg). This increase indicates that essential amino acid supplementation optimizes livestock growth. Amino acids such as lysine and methionine play a crucial role in protein synthesis, accelerating muscle tissue growth. This aligns with the NRC (2012) finding that the balance of amino acids in the ration significantly determines pig growth performance.

The increase in slaughter weight was accompanied by an increase in carcass weight, from 22.36 kg (P0) to 27.68 kg (P3). This indicates that the efficiency of body tissue deposition, particularly meat, improved in the nutrient-supplemented treatment. According to [5] , increased carcass weight is closely related to increased muscle growth and nutrient utilization efficiency.

However, carcass weight percentage did not show a significant difference (P>0.05) between treatments, ranging from 64.63–65.91%. This indicates that despite the increase in absolute weight, the proportion of carcass to live weight remained relatively stable. This condition commonly occurs when tissue growth occurs proportionally between carcass and non-carcass components [6]

3.1 Carcass Physical Composition

3.1.1 Meat Percentage

Meat percentage showed a significant increase in the highest treatment (P3), reaching 45.70%, compared to P0 (41.71%). This indicates that essential amino acid supplementation can increase protein deposition in muscle tissue.

Lysine is the main limiting amino acid in pig rations and plays a direct role in muscle tissue formation. Methionine and tryptophan also support protein metabolism and growth hormone regulation. According to [7], increased lysine intake is positively correlated with improved muscle growth and carcass quality.

3.1.2 Fat Percentage

Conversely, the fat percentage decreased significantly from 40.52% (P0) to 36.37% (P3). This decrease indicates that nutrient supplementation directs energy metabolism more toward protein formation than fat deposition.

Choline in the ration also acts as a lipotropic, aiding fat metabolism and preventing excess fat accumulation in the body. According to [8}, choline plays a role in lipid transport and fat metabolism in the liver, thereby reducing carcass fat accumulation.

3.1.3 Bone Percentage

Bone percentage showed no significant difference ($P>0.05$) between treatments, with a range of 17.45–17.70%. This indicates that bone growth was relatively stable and not significantly affected by amino acid supplementation at the levels provided.

According to [9] bone growth is generally more influenced by genetic factors and minerals (calcium and phosphorus), rather than amino acid supplementation.

The results of this study have important implications for the field of Animal Product Technology, particularly in improving the quality of raw meat materials. Increasing the percentage of meat and reducing carcass fat are key indicators for producing high-quality processed meat products.

Meat with a lower fat and higher protein content will produce processed products such as sausages, nuggets, and meatballs with better texture, higher water-holding capacity, and improved emulsion stability [10].

Furthermore, a leaner (lower-fat) carcass is also more in line with the preferences of modern consumers who desire healthier meat products. Therefore, this nutrient supplementation strategy can be applied to increase the economic value of Balinese pigs.

4 Conclusion

Administering a mixture of lysine, methionine, tryptophan, and choline at 15% of the requirement can increase slaughter weight, carcass weight, and meat percentage, while reducing fat percentage without affecting carcass and bone percentage.

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.

Statement of ethical approval

Based on the research, it is recommended that Balinese pig farmers using commercial feed (CP 551 for the starter phase and CP 552 for the grower phase) supplement their feed with 15% of the required mixture of lysine, methionine, tryptophan, and choline to improve carcass performance for male Balinese pigs during the starter-grower phase.

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