Research Article

Effects of Adding Soybean Waste on Growth Performance and Carcass Quality in Quails

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Abstract | This study determined the effects of feeding soybean waste at different levels on the growth performance and carcass quality in quails (*Coturnix coturnix*). Forty-five male broiler quails aged two-days-old were reared for three weeks before they were used for the experiment. At the start of the experiment, the quails were divided into 3 groups of 15 quails per group. Group 1 (T0) was treated with 100% commercial diet without soybean waste, Group 2 (T1) was treated with 15% soybean waste + 85% commercial diet, and Group 3 (T2) was treated with 30% soybean waste + 70% commercial diet. For growth performance, the body weight and average daily gain were measured. Meat qualities were evaluated based on the dressing weight, pH, and meat proximate analysis. The results revealed that the body weight, average daily gain, dressed weight and pH value were significantly differ (p<0.05) in treated group 3 compared to the control without soybean waste. The carcass crude protein and fat were also significantly (p<0.05) better. In conclusion, adding soybean waste into quail diet for up to 30% could be a potential protein source that enhances the growth and improves meat quality of quails.

Keywords | Growth performance, Meat quality, Quails, Soybean waste

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INTRODUCTION

Quail farming for meat and egg production is increasing steadily due to the huge demands for meats following the increasing populations in both rural and urban areas. More people prefer to eat quails because the meat is tasty, while the eggs are nutritious as compared to other poultry eggs. However, feed cost is a major problem in poultry production together with other problems such as lack of knowledge on disease prevention, breeding process, and disease outbreaks (Ardiansyah et al., 2022; Elsedig et al., 2015). Furthermore, animals are the major users of land and water that contribute to greenhouse gas emission (Sjofjan and Adli, 2021). Nevertheless, due to the consistent animal protein requirement, a balance between of animal protein production and development of animal

industry is needed (Adli, 2021).

Soybean waste is a by-product of tofu and soymilk productions. Soybean wastes are commonly dumped directly to the water system, polluting the environment. In fact, soybean waste consists of approximately 50% crude fibre, 25% protein, 10% lipid, and other nutrients, therefore, is an inexpensive source of protein (Cheng et al., 2005). In addition, soybean waste contains high quality proteins, especially the essential amino acids that can be used to fulfil animal's daily nutrient requirements. Protein is an essential key ingredient of animal feeds and is necessary for animal growth, body maintenance and development. On the other hand, Ekeocha et al. (2020) reported that soybean contains anti-nutritional factors that can be digested by poultry. The anti-nutritional factors are trypsin inhibitors, lectins, and saponin that reduce the growth and the meat quality.

Naturally, poultry feed depends heavily on the cereals and leguminous plants as sources of energy and protein (Kolo et al., 2019), but lacking in studies on utilization of soybean waste as feed for quails. Using soybean waste as feed supplementation can reduce the feed costs and increases the efficiency of feed conversion into meat (Frempong et al., 2011). This research evaluated the optimum nnutritional composition of soybean waste, and its effects on the growth performance and meat quality of quails. This study identified the optimum inclusion level of soybean waste into quail feed and evaluated the potential in enhancing the growth performance and improving the meat quality of quails.

MATERIALS AND METHODS

Ethical approval

The Institutional Animal Care and Use Committee (IACUC) had approved the proposed animal utilisation protocol for this experiment. Approval AUP number was U035/2020.

Experimental design

Forty-five broiler male Japanese broiler quails aged two-days-old purchased from a local hatchery were weighed and divided into three groups which per group with 15 quails per group. Each group was reared and housed in environmentally-controlled-room with wood shaving as bedding. At the start of the experiment, quails of group 1 were fed with 0% soybean waste+100% commercial diet, group 2 with 15% soybean waste+85% commercial diet, and group 3 with 30% soybean waste+70% commercial diet (Table 1). All quails were allowed *ad libitum* access to drinking water through adjustable nipple drinkers. Each treatment was randomized as a complete block design. The experiment lasted 21 days. The commercialize starter/grower diet for the Japanese quails and soybean waste were purchased from a trusted supplier. The composition of starter /grower diet and nutrient composition of soybean waste were tabulated in Table 2 and Table 3, respectively.

Table 1: Compositions of the formulated diet for the Japanese quails.

Groups	Soybean waste	Commercial feed
1*	0%	100%
2	15%	85%
3	30%	70%

*Control group.

Group 1 (T0) was treated with 100% commercial diet without soybean waste, Group 2 (T1) was treated with 15% soybean waste + 85% commercial diet, and Group 3 (T2) was treated with 30% soybean waste + 70% commercial diet.

Table 2: Gross composition of Japanese quails starter/grower diet.

Ingredients	Composition (%)
Maize grain	48.00
Fish meal	15.60
Soybean meal	35.00
L-lysine HCL	1.50
Dicalcium phosphate	1.00
Calcium	1.00
DL-methionine + cycstine	0.90
Total phosphorus	0.80
salt	0.30
Vitamin and mineral mix	0.10
Metabolize energy	2800 Kcal/Kg
Crude protein	28.00

Table 3: Nutrient composition of the soybean waste.

Parameters	Soybean waste
Dry Matter (%)	92.08
Ash (% DM)	1.05
Crude Fibre (% DM)	20.18
Crude Fat (% DM)	7.68
Crude Protein (% DM)	23.85

Sample preparation

Feed formulations for treatment groups were prepared using Windows User-Friendly Feed Formulation (WUFFDA) to meet the minimum requirement of nutrients such as crude protein. The soybean waste was dried in the oven at 60C for 2 days. Then, each ingredient was weighed using an analytical balance before the reading was recorded. All ingredients were then mixed thoroughly. A total of 7 kg samples were prepared for each experimental diet. The experimental diets were kept in labelled airtight plastic con-

tainers before proceeded to proximate analysis. Representatives of the formulated feed were analysed for dry matter (DM, Method: 950.05), crude protein (Method: 984.13), crude fat (Method: 920.39) and ash (Method: 942.05) (AOAC, 2007). Compositions of the formulated feed are summarised in Table 4. The remaining feed was stored in sack bags as daily feed for the quails. The observed parameters were dry matter, ash, crude fibre, crude fat and crude protein.

Growth Performance

The body weight of each quail was taken at day 0, 7, 14 and 21 days of the feeding trials (Ardiansyah et al., 2022). The average daily gain was determined by dividing the increase in body weight over the experimental period by the length of the experimental period (21-day experiment) (Mohd Azmi et al., 2021).

Meat quality and proximate analysis

At the end of the experiment (Day 21), 5 quails were randomly selected and slaughtered at a commercial government abattoir (Slaughterhouse, Universiti Putra Malaysia) according to the standard procedure (Muslim la; MS15000:2009) of the Department of Standard, Malaysia. After slaughtering, the meat samples were analyzed for pH and dressed weight (Nasr et al., 2017). Furthermore, for the crude protein (Method: 984.13) and crude fat (Method: 920.39) of the meat samples were determined in accordance to the methods specified in AOAC (AOAC, 2007).

Statistical analysis

All the statistical analyses were performed using SPSS version 25. For data with normal distribution, one-way analysis of variance (ANOVA) was used with the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where Y_{ij} was the parameter observed, μ was the overall mean, T_i the effect different soybean waste level and e_{ij} the amount of error. The data that were not normally distributed were analysed using the Kruskal-Wallis test. Post-hoc Dunnet's test was also used to identify pairs with significant differences. Statistical difference between groups was determined and the differences was considered to be statistically significant when p was less than 0.05.

RESULTS AND DISCUSSION

Proximate analysis of the feed and growth performance

It was revealed that all elements were higher in the group 3 diet except for the dry matter and ash contents which were higher in the control group 1. The high crude protein (46.43%), crude fat (2.17%) and crude fibre (7.00%) of the diet of group 3 indicated higher feed nutritional values that would aid for a better growth performance since these components are essential in promoting growth of Japanese Quails (Dahouda et al., 2013). In fact, soybean waste that contains about 50% dietary fibre, 25% protein, 10% lipid and other nutrients has good nutritional values and functional properties (Marques et al., 2011). Furthermore, soybean waste was used in this study because of its easy availability in the local markets, and the discarded soybean waste could contaminate the environment. Therefore, utilization of soybean waste would increase the economic benefits as it is cheaper as well as could decrease the environmental pollutions. There were also shown in other studies that soybean waste was used as an alternative animal feed as a cheaper source and high nutrients contents (Maidala et al., 2019).

Table 5 shows the growth performance of the quails from the three different groups. Highest body weight increments could be observed in group 3 with the average final body weight of 106.60g and the average initial weight of 35.42g. This followed by group 2 with 15% soybean waste that resulted in the average final weight of 100.14g and the average initial weight of 35.91g. The least increment could be observed in control group 1 with the average final weight of 97.67g and the average initial weight of 34.25g. Similarly, group 3 provided the highest mean body weight gain throughout the 3-week feeding period. The body weight of quails of group 3 was significant higher (p<0.05) than the other groups. The ADG of group 3 was 3.39 g/day, followed by group 2 at 3.06 g/day, and control group 1 at 3.02 g/day.

Growth performance of quails can be evaluated using the body weight gain and the average daily gain (ADG) (Cabaral et al., 2017). Body weight gain is calculated based on the initial and final body weights. This experiment revealed that 30% soybean waste resulted in better growth, probably due to the high protein, fat and fiber contents in the feed of group 3 (Vatsalya and Arora, 2011). Growth can be associated with an accretion of nutrients in the body over the lifetime of an animal (Vatsalya and Arora, 2011). Recently, non-degraded fibre has been correlated with "wet" droppings which contribute to sanitation problems (Adli et al., 2022).

Meat Quality

Table 5 also shows the carcass quality of quail's of the three different groups. Highest pH value was observed in the control group 1, followed by group 2 (pH 6.16) and group 3 (pH 6.07), which was significantly (p<0.05) lower. This table 5 showed the highest dressed weight was in group 3, at 61.30g, significantly (p<0.05) higher than the 57.71g of

Table 4: Proximate analysis of the formulated diet for the Japanese quails.

Parameters	Group 1	Group 2	Group 3	SEM	*p*-value
Dry Matter (%)	99.52	99.15	99.14	1.32	1.827
Ash (% DM)	16.33[a]	14.17[b]	14.17[b]	2.48	0.042
Crude Fibre (% DM)	5.00[b]	5.05[b]	7.00[a]	0.79	0.041
Crude Fat (% DM)	1.50[b]	1.67[b]	2.17[a]	0.03	0.035
Crude Protein (% DM)	41.38[b]	41.60[b]	46.63[a]	2.84	0.048

[a,b] different superscripts indicate significant difference on proximate parameter on formulated diet for the Japanese quails at $p<0.05$.

Table 5: Effects of addition of different levels of soybean waste on growth performance and carcass quality of quails.

Parameters	Group 1	Group 2	Group 3	SEM	*p*-value
Growth performance					
Initial body weight at day 0 (g)	34.25	35.91	35.42	0.32	0.159
Final body weight at day 21 (g)	97.67[c]	100.14[b]	106.60[a]	1.84	0.034
Average daily gain (g/day)	3.02[b]	3.06[b]	3.39[a]	0.25	0.047
Carcass quality					
pH value of meat	6.22[a]	6.16[b]	6.07[c]	0.05	0.049
Dressed weight (g)	54.89[c]	57.71[b]	61.30[a]	3.62	0.031
Crude protein of meat (%)	63.87[c]	74.92[b]	78.38[a]	4.80	0.048
Ether extract of meat (%)	19.17[a]	16.50[b]	15.33[c]	1.87	0.044

The values are presented as mean; [a,b,c] different superscripts within row indicate significant difference at $p<0.05$. Group 1: Control group (0% soybean waste), Group 2: Treatment 1 (15% soybean waste) and Group 3: Treatment 2 (30% soybean waste).

group 2 and the lowest 54.89g of group 1. However, Yasar et al. (2020) reported that fermented soy-bean meal causes bad taste to the meat. The high dressed weight of group 3 was due to the high final body weight.

Meat quality of quails is measured by the pH value, dressed weight and nutritional compositions of the quail's meat, particularly the crude protein and crude fat. According to Elsedig et al. (2015), pH of meat ranges between 5.87 and 6.53, depending on the glycogen content in the muscles. The glycogen is broken down to lactic acid when muscle turns into meat. When the glycogen level in live muscle falls below the acceptable threshold, the meat would register a high pH. In fact, there are several strains of lactic acid bacteria and yeast that involve in the broken down of glycogen. They include *Lactobacillus acidophilus, Lactobacillus casei, Lactobacillus plantarum, Lactobacillus salivarius, Lactobacillus delbrueckti, Lactobacillus lactis, Bacillus subtilis, Bacillus bifidum, Bacillus subtilis, Saccharomyces cerevisiae* (Adli et al., 2021). Both *Trichoderma spp* and *Saccharomyces cerevisiae* are potential candidates as fermented substrate for raw materials (Adli, 2021; Ghavidel-Heydari et al., 2021; Sjofjan and Adli, 2021). Nevertheless, soya bean meal has been found to contain *Salmonella spp.* (Wengerska et al., 2022).

The crude protein composition of quails is summarized in Table 5. Quails of group 3 showed the highest crude protein composition at 78.38%, followed by group 2 at 74.92% and the control group 1 at 63.87%. Dong et al. (2005) revealed that 60% of the soybean meal in diets can be replaced by soybean waste for growing ducks. Similarly, this study suggested that soybean waste is a potential waste product that can be formulated into quails feed due to the high nutritional value, especially the protein contents, and high protein diets affect the protein level in quail. However, it is important to balance the energy-protein levels in poultry feed. This is because feed intake is curvilinear with energy-protein requirement and follows the differences between energy and protein requirements (Sjofjan et al., 2022).

Crude fat compositions of quails of each group are summarized in Table 5. Again, quails of group 3 showed the lowest crude fat composition at 15.33%, followed by group 2 at 16.50%, control group 1 at 19.17%. Boni et al. (2010) revealed that crude fat content is low in quail's meat, at around 12.91%. Therefore, quail might be a healthier option for people who are on diet or want to lose weight. The quail's meat has lower calory and higher protein levels than chicken and duck meats. Also, the fat content is lower in quail than in chicken and duck meats (Lonita et al., 2008).

CONCLUSIONS

This study has shown that inclusion of soybean wastes for up to 30% into the diet has a potential to enhance the growth performance of quails. It also improves the meat

quality by having low pH, higher dressed weight and high protein composition in the meat.

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CONFLICT OF INTEREST

None of the authors of this paper has any financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

NOVELTY STATEMENT

Since there is limited information of soybean waste on growth performance and carcass quality in quails, the novelty of this report suggests an alternative use of soybean waste on growth performance and carcass quality in quails.

AUTHOR'S CONTRIBUTION

AFMA conceptualization, drafting the original manuscript, WRH collecting data, ZARA collecting data, HNA collecting data, DNA writing the original manuscript, drafting manuscript, revise grammatically, creating illustration, and validation, and HAH supervision, data validation.

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