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Research Reports

Effects of Dietary Soy Sauce Dregs and Cassava Peel Meal on the Performance of Production and Reproduction of Grower Quails *(Cortunix cortunix Japonica)*

Pengaruh Pemberian Ampas Kecap dan Tepung Kulit Singkong Terhadap Performa Produksi dan Reproduksi Puyuh Fase *Grower (Cortunix cortunix Japonica)*

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ABSTRACT

Background: The cost of feed is a significant factor in the viability of a quail farming business. **Purpose:** This study aims to determine the effects of dietary soy sauce dregs and cassava peel meal on the performance production and reproduction of grower quails *(Cortunix cortunix Japonica)*. **Methods:** This study employed four treatment groups, each with five replicates, namely P0 (control), P1 (5%), P2 (10%), and P3 (15%). The parameters observed were feed consumption, body weight gain, feed conversion ratio, mortality, body weight at sexual maturity, egg weight, and laying age. Data analysis was conducted using the analysis of variance (ANOVA) test, followed by the Duncan's multiple range test (DMRT) to identify any significant differences. **Results:** The results showed that the addition of soy sauce dregs and cassava peel meal to the feed up to 15% to the treatment group resulted in significant effects ($p < 0.05$) on feed consumption, egg weight, and laying age. However, it had no significant effect on body weight, feed conversion ratio, mortality, and body weight at sexual maturity. **Conclusion:** The supplementation of soy sauce dregs and cassava peel meal up to 15% in grower quail diets resulted in improvements in the performance of both production and reproduction of grower quails, as evidenced by increased feed consumption, egg weight, and laying age.

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ABSTRAK

Latar Belakang: Pakan merupakan salah satu masalah biaya yang menentukan keberhasilan usaha ternak puyuh. **Tujuan:** Pakan ampas kecap dan tepung kulit singkong terhadap performa produksi dan reproduksi puyuh grower *(Cortunix cortunix Japonica)*. **Metode:** Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) 4 perlakuan 5 ulangan yaitu P0 (kontrol), P1 (5%), P2 (10%), P3 (15%), Parameter yang diamati adalah konsumsi pakan, pertambahan bobot badan, konversi pakan, mortalitas, bobot badan, bobot telur, dan umur bertelur. Analisis data menggunakan uji ANOVA, jika terdapat perbedaan yang signifikan dilanjutkan dengan uji DMRT. **Hasil:** Hasil penelitian menunjukkan bahwa penambahan tepung ampas kecap dan tepung kulit singkong dalam pakan hingga taraf perlakuan 15% pengaruh nyata ($p<0,05$) terhadap konsumsi pakan, bobot telur, dan umur pertama kali bertelur tetapi tidak berpengaruh nyata terhadap pertambahan bobot badan, rasio konversi pakan, mortalitas, bobot badan puyuh saat dewasa kelamin. **Kesimpulan:** Pemberian tepung ampas kecap dan tepung kulit singkong dalam pakan puyuh grower sampai taraf 15% mampu meningkatkan performa produksi dan reproduksi puyuh fase grower, termasuk peningkatan konsumsi pakan, bobot telur serta umur puyuh saat pertama kali bertelur.

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Kata kunci: Ampas Kecap; Kulit Singkong; Performa; Puyuh; Reproduksi

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INTRODUCTION

According to 2022 statistical data on agriculture, the development of quail farming businesses in Indonesia shows that the quail population increased from 15,222,580 in 2020 to 15,227,131 in 2021. As noted by Rosnah *et al.,* (2021), the development of quail farming businesses on both small and large scales holds significant potential due to its minimal operational costs, lack of requirement for a vast area of land, and straightforward maintenance process. Therefore, the development of quail farming businesses must be carefully managed in order to support and facilitate their contribution to the fulfillment of nutrition. In order to achieve optimal growth performance and reproduction in quails, it is necessary to consider genetic factors, environmental conditions, maintenance practices, and feed management strategies.

Feed is a crucial aspect in livestock businesses. The nutrient content of the feed can be adjusted to the needs of the quails to ensure optimal growth and reproduction. In terms of economic aspects, the most significant challenge faced by livestock businesses is the cost of feed. Solomon *et al.,* (2019) suggested that feed expenses accounted for up to 70% of total production costs in livestock. This occurs due to the high cost of feed ingredients, which results in the relatively high feed prices. Despite the relatively modest consumption of quail feed, the cost of feed does not always align with the production results. Therefore, it is necessary to incorporate additional feed ingredients to increase feed cost efficiency, one of which is by reducing the quantity of basal feed and providing additional feed from waste.

Soy sauce dregs are a feed ingredient derived from processed soy sauce waste, a protein source feed ingredients that can be used to support nutritional needs in livestock. Soy sauce waste has a crude protein nutritional content of 26.60% Yasuda *et al.,* (2016) and Xu *et al.,* (2019) found that soy sauce waste is often used as a potential supplementary feed. On the other hand, the high NaCl content of the feed may result in excessive water consumption by quails, leading to increased water content in the body and the formation of wet feces. Therefore, the use of soy sauce waste as a livestock feed must be limited and processed prior to its administration to livestock. Herdiana *et al.,* (2014) suggested that soaking the soy sauce waste reduces the NaCl content by 18.8%. Another feed ingredient derived from other waste, such as cassava peel, can be incorporated into the feed to provide an abundant source of energy.

Cassava peel is a byproduct feed ingredient derived from cassava. It has the potential to meet the energy requirements for activity and production. The metabolic energy content of cassava peel is 2436.64 kcal/kg (Mirzah and Muis, 2016). In addition, the protein content of cassava peel ranges from 46 to 55 g/kg, which can compensate for protein deficiencies. Evans *et al.,* (2023) suggested that cassava peel contains 4.56% of protein. However, this is accompanied by the anti-nutritional substance, namely cyanide acid (HCN), that is harmful to quails and causes poisoning and death. The HCN content of cassava peel ranges from 100 to 200 mg/kg. Therefore, it is necessary to process cassava skin into flour using certain procedures. The process begins with washing the cassava peel and soaking it in water, followed by boiling, and drying to reduce the HCN content (Morgan and Choct, 2016). This study aims to determine the effects of using soy sauce waste and cassava peel as feed ingredients on the performance of production and reproduction of grower quails.

MATERIAL and METHOD

Materials

This study used 180 Golden laying quails aged 14 days old with an average body weight of 59.11 ± 3.9 g. The materials used included water, sugar, formalin, disinfectants, drugs, vitamins, soy sauce dregs, cassava peel, and starter quail feed as basal ration (PT. Japfa Comfeed, PP1). The composition of the feed ingredients and the nutrient contents of the feed are presented in **Table 1.**

Table 1. Composition of Feed Ingredients and Nutrient Contents of the Feed.

Ingredients	Treatments			
	P0*	P1**	P2**	P3**
Basal ration (%)	100	95	90	85
Cassava peel meal (%)	-	2.5	5	7.5
Soy sauce dregs meal (%)	-	2.5	5	7.5
Total (%)	100	100	100	100
	Nutrients			
Moisture (%)	12	11.72	11.68	11.37
Ash (%)	8	6.25	6.34	6.22
Dry mater (%)	-	88.28	88.42	88.63
Crude protein (%)	23	27.48	27.49	27.56
Crude fat (%)	3.00-7.00	5.06	4.77	4.36
Crude fiber (%)	5	4.18	4.05	3.63

Note: Source: * Feed label (PT Japfa Comfeed Indonesia Tbk.); ** Laboratory analysis

Research Methods

The study used a completely randomized design with four treatments, each with five repetitions. Each treatment group consisted of nine quails divided as follows: P0 = Basal feed (control); P1 = 95% basal feed + 2.5% soy sauce dregs meal and 2.5% cassava peel meal; P2 = 90% basal feed + 5% soy sauce dregs meal and 5% cassava peel meal; P3 = 85% basal feed + 7.5% soy sauce dregs meal and 7.5% cassava peel meal

Research Design

The process of transforming soy sauce waste into feed began with soaking soy sauce waste in water for 24 hours in a ratio of one kg of soy sauce waste to two liters of water, followed by rinsing in running water, and drying in the sun for four days (Herdiana *et al.,* 2014). On the other hand, the processing of transforming cassava peel into feed began with washing the cassava peel, followed by soaking in water for four days, boiling for 45 minutes, and drying for four days.

The processed soy sauce waste and cassava peel were mixed in a ratio of 1:1 and added to the basal feed according to the dietary requirements of each treatment group. The treatment began at the age of 15 days until the quails laid their first eggs or became sexually mature. The feed was administered twice a day in the morning and evening. In addition, the quals were provided with drinking water ad libitum.

The parameters observed related to the production performance of the quails included feed consumption, body weight gain, feed conversion ratio, and mortality rate. Food consumption was calculated by subtracting the amount of feed consumed from the amount of feed administered (g/quail/week). Body weight gain was calculated by subtracting the weight at the end of the week from the weight at the beginning of the week (g/quail/week). Feed conversion ratio was calculated by dividing the amount of feed consumed by body weight gain. Finally, mortality rate was calculated as the percentage of deaths in a week. Meanwhile, the parameters observed related to the reproductive performance included body weight at sexual maturity (g/quail), egg weight (g/egg), and laying age.

Data Analysis

The data were analyzed using the analysis of variance (ANOVA) test. Variables that showed significant effects ($p < 0.05$) were subjected to the Duncan's multiple range test (DMRT) to determine the average comparisons. All data were tested using the Statistical Product and Service Solutions (SPSS) application.

RESULTS

Feed Consumption

The results showed a significant effect of the treatments on feed consumption ($p < 0.05$) **(Table.2)**. Feed consumption was found to be higher in the P0 group (437.94 g/quail) than in the P1 (424.36 g/quail), P2 (425.89 g/quail), and P3 (401.53 g/quail) groups. However, the results showed no significant effect of the treatments on body weight gain ($p > 0.05$). Body weight gain in the P0, P1, P2, and P3 groups were 95.26 g/quail/week, 95.92 g/quail/week, 97.33 g/quail/week, and 91.28 g/quail/week, respectively. In other words, the average body weight gain during the treatment period was between 91.28 and 97.33 g/quail/week. In addition, the results showed no significant effect of the treatments on food conversion ratio ($p > 0.05$). The average FCR during the treatment period was between 4.37 and 4.60. Finally, the results showed no significant effect of the treatments on mortality rate ($p > 0.05$).

Table 2. Average Quail Production Performance.

Parameters	Treatments				
	P0	P1	P2	P3	p-Value
Feed consumption (g/quail/week)	437.94 ± 11.36^{b}	424.36 ± 26.25^{b}	425.89 ± 3.17^{b}	401.53 ± 10.32^{a}	0.01
Average body weight (g/quail/week)	95.26 ± 3.76^{a}	95.92 ± 5.43^{a}	97.33 ± 2.43^{a}	91.28 ± 4.88^{a}	0.18
Feed conversion ratio	4.60 ± 0.17^{a}	4.44 ± 0.45^{a}	4.37 ± 0.96^{a}	4.40 ± 0.18^{a}	0.56
Mortality (%)	0^{a}	2.22 ± 0.44^{a}	0^{a}	2.22 ± 0.44^{a}	0.58

Note: P0 = basal feed (control); P1 = 95% basal feed + 2.5% soy sauce dregs meal and 2.5% cassava peel meal; P2 = 90% basal feed + 5% soy sauce dregs meal and 5% cassava peel meal; P3 = 85% basal feed + 7.5% soy sauce dregs meal and 7.5% cassava peel meal Different superscripts in the same row indicate a significant difference ($p < 0.05$).

Reproduction Performance

The results showed in **Table 3**, that the treatments had no significant effect on the body weight at sexual maturity. The average body weight of the quails was the greatest in the P3 group (171.84 g/quail), while it was the smallest in the P0 (control) group (162.22 g/quail). The average body weight of the quails at sexual maturity ranged from 162.22 to 171.84 g/quail. Furthermore, the results showed that the treatments had a significant effect on egg weight ($p < 0.05$). The average egg weight was the greatest in the P2 group (9 g/egg), while it was the smallest in the P0 (control) group (7.2 g/egg). The average weight of quail eggs at the beginning of being laid ranged from 7.2 g/egg to 9 g/egg. The results showed that the treatments had a significant effect on laying age ($p < 0.05$). The average laying age of the P0, P1, P2 groups was 37 days, while that of the P3 group was 39 days. The average laying age was between 37 and 39 days.

DISCUSSION

The incorporation of soy sauce dregs and cassava peel in the diet of quails of up to 15% resulted in a reduction in feed consumption. The reduction in feed consumption in the P3 group was attributed to the diminished palatability of livestock in combination with the increased amount of flour, dregs, soy sauce, and cassava peel. This finding is consistent with the findings of Mishra *et al.*, (2015) which suggested that diminished palatability may result in a decrease in feed consumption. One possible explanation for this reduction in feed consumption is that the processing of cassava peel has not been effective in reducing HCN levels.

The addition of soy sauce waste flour and cassava peel flour to the feed in the P3 group resulted in a reduction in body weight gain. The average body weight gain during the treatment ranged from 91.28 to 97.33 g/quail/week. These findings are still below those reported by Jatoi *et al.*, (2018), which found a rage between 105.51 and 117.85 g/quail aged three to five weeks. This difference is likely due to differences in quail feed consumption between the two studies. In other words, lower feed consumption in the P3 group resulted in lower body weight gain. This is consistent with the findings of Abu and Judah, (2019), which found that body weight gain of laying quails is directly proportional to their feed consumption. In other words, the higher the feed consumption, the greater the weight gain. Conversely, if a reduction in feed consumption will result in a deficiency of nutrients, potentially influencing body weight gain. Malik *et al.*, (2018) suggested that adding cassava peel in the feed can reduce body weight because of its crude fiber content and residual HCN. Another factor that can influence the weight gain of quails is ambient temperature. According to Bonfim *et al.*, (2016), ambient temperature can affect body weight and growth.

The addition of soy sauce waste flour and cassava peel flour to had no significant effect on feed conversion ratio (FCR) ($p > 0.05$). The results of treatment in the P3 group were comparable to those of the P0, P1, and P2 group. The average FCR during the treatment period ranged from 4.37 to 4.60. The results of feed conversion are considered effective at a rate of 10% because it indicates a high feed consumption rate, followed by a big weight gain. However, a greater body weight gain leads to a lower feed conversion ratio. In this study, the low FCR value was consistent with the findings of Mishra *et al.* (2015), which found a range of FCR between 5.78 and 7.00

in quails aged between three to five weeks. This ratio is influenced by factors, such as livestock activity, temperature, size, and feed consumption (Silitonga *et al.,* 2018).

This study found a mortality rate of 2.22%, indicating that quail mortality during the treatment period was low. Therefore, it can be concluded that the mortality was not due to the use of soy sauce dregs and cassava peel in the feed. Instead, the deaths were attributed to other factors, such as the environment, provision of drinking water, ration quality, good human resources, and maintenance management (Rohman *et al.,* 2018).

The body weight of quails during the first laying of eggs was the greatest in the P3 group. However, the treatment did not yield significant results ($p > 0.05$). The average body weight of quails during the first laying of eggs ranged from 162.22 to 171.84 g/quail. These findings are consistent with the findings of Bobadilla-Mendez *et al.,* (2016), which found a range between 161.8 and 182.9 g/quail during the first laying of eggs. However, the increase in quail body weight during the first laying of eggs was attributed to the influence of high crude protein content in the feed (Prabakaran and Valavan, 2020). The treatment received by the P3 group had a higher protein content than that of other groups. Other factors that influence body weight include temperature, cage environmental conditions, and cage density.

The treatments showed a significant effect on egg weight ($p < 0.05$). The average egg weight ranged from 7.2 to 9 g/egg. The greatest egg weight was observed in the P1 group (9 g/egg), while the smallest eight weight was observed in the P0 group (7.2 g/egg). These findings are consistent with the findings of Arunrao *et al.,* (2023), which observed an egg weight of 9.84 g at the age of six weeks. Meanwhile, Bobadilla-Mendez *et al.,* (2016) observed that the weight of quail eggs at the time of sexual maturity ranged from 8.20 to 9.25 g and that the increase in egg weight was influenced by protein consumption, quail weight, and production period. In this study, the egg weight of the P1 group was greater than that of the P2 and P3 groups due to the higher protein content of the feed than that of the feed provided to the P0 group. This finding is consistent with the findings of Hertamawati *et al.,* (2019), which suggested that the higher the protein consumption, the greater the egg weight. Other factors that can influence egg weight include environmental conditions, maintenance management, and most importantly, rations. Quail eggs weigh approximately 7% to 8% of the weight of the quails, which ranges from eight to 12 g (Setyawan *et al.,* 2013).

The average age during the first laying of eggs in the P3 group was older (39 days) that that of the P0, P1 and P2 groups (37 days). Previous studies showed varying results. For example, Arunrao et al. (2023) found that the average age during the first laying of eggs ranged from 48 days to 52 days, while Prabakaran and Valavan (2020) found that the average age was 40 days. The age during the first laying of eggs can be affected by the nutrient content of the feed and the intensity of lighting. According to Berliana *et al.,* (2018), once quails reach the optimal body weight, they will begin laying eggs. In addition, Ratriyanto (2018) suggested that the age of sexual maturity is closely related to egg production because faster sexual maturity will accelerate the peak of production.

CONCLUSION

The incorporation of soy sauce dregs and cassava peel meal into the diet of grower quails of up to 15% has been shown to affect the performance of production and reproduction. This is evidenced by increased feed consumption and egg weight, but delayed laying age.

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CONFLICT of INTEREST

The author declares no conflict of interest.

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ETHICAL APPROVAL

This study received ethical approval from The Ethical Committe of Medical Researvh, Faculty of Dentistry Universitas Jember with a certificate number 2220/UN25.8/KEPK/DL/2023

AUTHORS' CONTRIBUTIONS

MMU (research design and manuscript preparation), WHRJ (data collection), and RTH (data analysis and correction/revision).

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