Growth performance and carcass yield of male quail (Coturnix-coturnix japonica) fed fermented rubber (Hevea brasiliensis) seed meal

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Abstract: This study investigated the effects of fermented rubber seed meal (processed with tempeh yeast, *Rhizopus oligosporus*) on the growth and carcass production of quail, both male and female, from 1 to 5 weeks of age. Using a Completely Randomized Design (CRD), around 260 male quails, aged 0 to 5 weeks, were divided into four groups to receive different levels of fermented rubber seed meal (FRSM). The groups were as follows: R0 (control, no FRSM), R1 (4% FRSM), R2 (8% FRSM), and R3 (12% FRSM). Each treatment had five replicates, with 13 male quails per replicate. The study measured feed consumption, body weight gain, feed conversion, and carcass production. The findings showed that adding fermented rubber seed meal to the quails' diet did not significantly affect feed intake, weight gain, feed conversion ratio, final body weight, carcass weight, or carcass percentage. The conclusion was that up to 12% of fermented rubber seed meal in the diet does not harm the growth performance or carcass production of quails.

Key words: rubber seed fermentation, tempeh yeast, cyanide acid, quail carcass

1. Introduction

The nutritional requirements for the development of quail are quite high, especially for the fulfilment of protein feed. It takes feed with a protein content of 23 to 25% to get optimal growth and productivity of quail during the growth period [1]. The protein source that is often used in commercial feed is fish meal. The relatively expensive price of fish meal makes the price of commercial feed expensive, so it is necessary to do research using alternative raw materials that are cheaper and have abundant and sustainable availability.

Rubber seeds as an alternative raw material suitable for use as a protein source substitute have been researched on layers [2], broilers [3], chickens [2], and ducks [4]. The advantage of rubber seed flour which is produced from the seeds of the rubber plant, are the most widely grown plantation crop in Indonesia so that its availability in large quantities is relatively guaranteed.

Previous researchers have found that *Hevea brasiliensis* dry seeds contain 17-25% protein [5], The composition includes 50.2% crude fat, 6.5% crude fiber, 3.6% ash, and 18.2% carbohydrates, as well as moderate levels of trace minerals [6]. Additionally, other research [7] the analysis revealed that rubber seeds consist of 92.22% dry matter, with nutrient contents including 19.20% crude protein (CP), 47.20% crude fat, 6% crude fiber, 3.49% ash, and 24.11% nitrogen-free extract (NFE). These nutritional values can vary based on factors such as the seed variety, harvest age, soil type, processing techniques, and storage conditions. Although rubber seed meal has an adequate protein content, it also contains anti-nutritional factors (ANFs), particularly cyanogen glycosides, which can convert into hydrogen cyanide and adversely affect physiological and metabolic processes. [8]. Fresh rubber seeds contain various anti-nutritional factors, including tannins (0.07%), saponins (0.76%), oxalates (0.18%), and phytates (0.51%), as well as a toxic compound. These substances can cause gastrointestinal problems and decrease metabolic activity when the seeds are used directly in animal feed. [9]. It is the hydrocyanic acid [3], whose rate is 24.89 % [6], similar to cassava cyanic acid [10]. Fresh rubber seeds contain 1,200 ppm of HCN and 27 ppm of rubber seed cake meal [9].

Processing of rubber seed by utilizing fermentation technology which is one way to reduce HCN content [7]. Fermentation can enhance the digestibility of feed ingredients by breaking down complex substances through enzymes produced by fermenting

microbes[5][11]. One of the inoculants that can be used in the fermentation of rubber seeds is tempeh yeast. Fermented rubber seeds with Rhizopus oligosporus could reduce HCN by 18 times lower (573.72 ppm to 30.75 ppm) [3]. Tempeh yeast comprises four mold species: *Rhizopus oligosporus, R. orizae, R. stolonifer, and R. arrhizus*. Additionally, it includes various bacteria, such as *Klebsiella, Bacillus species, Lactobacillus species, Pediococcus species,* and *Streptococcus species*, along with other bacteria that produce vitamin B12 [12]. The fungus *Rhizopus sp*. contained in tempeh yeast can help hydrolyze the substrate to be simpler and making them easier to absorb in the digestive tract.

There has been limited research on the use of fermented rubber seed meal in quail diets. This study sought to evaluate how incorporating fermented rubber seed meal, treated with tempeh yeast, affects the growth and carcass yield of male quails.

2. Materials and methods

2.1 The source and processing methods of rubber seeds

The rubber seeds utilized in the study were sourced from a rubber plantation located in Jember, East Java, Indonesia.. All the seeds were collected fresh. They were cracked open to retrieve the contents and then cut into smaller pieces. To lower the cyanide acid levels in the seeds, they were soaked in water for 36 hours, followed by a 30-minute boil without a cover [13]. In the subsequent process, the rubber seeds are steamed for 10 minutes and then mixed evenly with 200 grams of yeast by stirring. The seeds are then wrapped in plastic with air circulation and stored for 7 days. The resulting rubber seed tempeh is dried and ground into flour, making it ready for use.

2.2 Experimental birds and management

The study's methods for handling and caring for the birds were approved by the Animal Ethics Committee at the Polytechnic State of Jember in East Java, Indonesia. The experiment involved 168 male quails, each one day old. These birds were weighed and then randomly assigned to one of five dietary treatment groups, with each group consisting of five replicates containing ten birds each, following a completely randomized design. The experiment spanned 35 days, during which each group had unrestricted access to its designated diet and clean water..

2.3 Experimental diets

Five distinct feed rations were formulated to fulfill the nutritional requirements of growing quails. The R0 diet, serving as the negative control, did not contain any tempeh rubber seed meal (TRSM). In contrast, the R1 diet, the positive control, incorporated 5% fermented TRSM. The R2 and R3 diets included 10% and 15% fermented TRSM, respectively, as outlined in Table 1. The specific nutrient composition of the fermented rubber seed meal is presented in Table 2.

2.4 Data Collection

Feed conversion data was taken from the division between one week's feed consumption and body weight gain for one week, the data was taken once a week. At the end of the research (35 days old), the percentage of carcasses was collected by comparing the carcass weight and live weight.

2.5 Statistical Analysis

The data were examined using Analysis of Variance (ANOVA) within a fully randomized design. To pinpoint differences among the treatment groups, Duncan's Multiple Range Test (DMRT) was utilized.

3. Results and Discussion

3.1 Growth Performance

Table 3 shows the average growth performance of quails from day 1 to day 35. The analysis of variance revealed that adding 12% tempeh rubber seed meal to their diet did not significantly impact their feed intake, body weight gain, or feed conversion ratio ($P>0.05$).

Dietary tempeh rubber seeds meal showed no significant influence on quail feed intake and palatability. By the opinion [14] that the palatability is reflected by the organoleptic, such as taste, smell, and texture. The findings of this study are consistent with those reported by [15] that the feeding of rubber seed flour in quail does not affect ration consumption, due to the palatability of the ration. The average feed intake in this study was 141.91-143.28 g/bird as reported by [16] research results that quails feed intake during the grower period averaged 131-154 g/bird.

Another factor that affects feed intake is the nearness of anti-nutritional substances in the ration, rubber seed flour contains anti-nutrient substances hydrogen cyanide (HCN) which are toxic and harmful to the quail. The alternative to reducing these toxins can also be soaked and fermented [17]. This research showed that fermentation with tempeh yeast reduced HCN levels from 158.64 ppm to 17.85 ppm. According to [2] rubber seed meal treated with soaking and fermentation processes will reduce the HCN content in rubber seeds. The increase in body weight has related to feed intake [18], which is an important factors and affect body weight gain.

The feed conversion value with TRSM was higher than the control feed, this indicates a decrease in feed efficiency. Several factors that affect feed conversion, namely digestibility, body weight gain and feed consumption according to [19] which states that

the factors affecting feed conversion include digestibility of feed quality, body weight gain, and feed intake.

3.2 Carcass Production

Table 4 illustrates the average body weight, carcass weight, and carcass percentage. According to the analysis of variance, adding tempeh rubber seed meal to the diet did not have a significant effect on the final body weight, carcass weight, or carcass percentage ($P>0.05$).

The average final body weight of quail in this study was 160.4 to 161.0 grams/bird. The final body weight that did not differ in each treatment was thought to be due to the consumption of the same feed from all the treatments carried out resulting in a relatively equal average live weight because one of the factors that affect live weight is feed consumption [20][21].

The average carcass weight obtained ranged from 107.39 to 111.77 grams/bird. The quality and production of carcass is closely related to live weight. The live weight of quail in this study was higher than the results of research conducted by [18] which stated an average live weight of 131 to 139 gram/bird.

Factors that affect carcass weight include live weight, species, genetics and the same age of slaughter. The study by [22] also concluded that including rubber seed meal in the diet did not significantly affect the carcass weight or the average carcass weight of quails. The average carcass percentage for each treatment was 69.59%, .68.58%, 66.947% and 67.97%. This result is similar to the results of studies [23] and [18] which stated that quail carcasses ranged from 62.26% to 75.75%. The percentage of carcass is determined by several factors, one of which is the live weight produced. The rate of the carcass is affected by live body weight, the rate of carcass begins from the development rate which

144 is demonstrated by the increment in body weight that will influence the coming about live
145 weight [24].

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Table 1. Ration formulations and nutrient contents of diet treatments

Ingredient	Treatment			
	R0	R1	R2	R3
	(%)			
Yellow corn	48.9	40.5	34.49	28
Rice bran	2	5.4	4	12,3
Layer concentrate*	49	50.01	50.7	45.5
Tempeh rubber seed meal (TRSM)	0.0	4	8	12
Mineral	0.1	0.09	2.81	2.2
Total	100	100	100	100
Nutrient				
Metabolize energy (kcal/kg)**	2901.15	2910.80	2901.32	2912,80

Crude protein (%)	24.00	24.74	24.99	24.00
Crude Fat (%)	3.92	5.11	6.13	7.39
Crude Fiber (%)	4.40	4.74	5.79	7.02
Ca (%)	1.14	1.16	1.34	1.19
P (%)	0.73	0.76	0.74	0.77

230 Description: ** ME content based the calculation

231 * PT. Wonokoyo Jaya Corp

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233 **Table 2**. Nutrient of Fermented Rubber seed Flour

Dry matter (%)	95,47
Ash (%)	2,03
Crude Protein (%)	16,18
Crude Fiber (%)	17,59
Extract ether (%)	32,43

Contains of HCN	
Rubber seed flour (ppm)	158,64
Fermented Rubber seed flour (ppm)	17,84

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235 **Table 3**. Means of quail growth performance

Feeding Treatments	Feed intake (g/bird)	Body weight gain (g/bird)	Feed Conversion
R0 (0% TRSM)	491.90±2.04	149.76±5.21	3.29±0.11
R1 (4% TRSM)	496.47±2.60	144.71±3.35	3.43±0.08
R2 (8% TRSM)	493.32±2.05	144.71±3.25	3.41±0.09
R3 (12% TRSM)	496.30±2.46	143.00±4.98	3.47±0.09

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237 **Table 4**. Means of carcass production

Feeding Treatment	Final body weight (g/bird)	Carcass weight (g/bird)	Percentage of Carcass (%)
R0 (0% TRSM)	160.4±4.62	107,39 ± 4,53	66,94 ± 1,57
R1 (4% TRSM)	160.4 ± 4.72	110,02 ± 5,08	68,58 ± 2,14

R2 (8% TRSM)	161.0 ± 6.16	109,45 ± 5,96	67,97 ± 2,42
R3 (12% TRSM)	160.6 ± 3.29	111,77 ± 3,55	69,59 ± 0,94

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