Growth Response and Carcass Yield of Male Japanese Quail Fed Diets Contained Fermented Rubber (*Hevea brasiliensis*) Seed Meal

Hertamawati RT[1*], Suryadi U[1], Prasetyo AF[1], Rahmasari R[2], Imam S[2], Asrianto N[1]

[1]*Poultry Business Management Study Program, Animal Husbandry Department, Politeknik Negeri Jember*
Jalan Mastrip 164 Jember, East Java, Indonesia
[2] *Feed Technology Study Program, Animal Husbandry Department, Politeknik Negeri Jember*
Jalan Mastrip 164 Jember, East Java, Indonesia
E-mail: rosa_trihertamawati@polije.ac.id

(received 24-08-2024; revised 04-11-2024; accepted 15-12-2024)

ABSTRAK

Hertamawati RT, Suryadi U, Prasetyo AF, Rahmasari R, Imam S, Asrianto N. 2024. Respon Pertumbuhan dan Produksi Karkas Puyuh Jepang Jantan yang Diberi Pakan Tepung Biji Karet (*Hevea brasiliensis*) Fermentasi. JITV 29(4):221-226. DOI: http://dx.doi.org/10.14334/jitv.v29i4.2450.

Penelitian ini mengevaluasi pemberian biji karet fermentasi menggunakan ragi tempe dalam pakan terhadap performa pertumbuhan dan produksi karkas puyuh jantan. Penelitian ini menggunakan metode percobaan Rancangan Acak Lengkap (RAL) dengan menggunakan sekitar 260 ekor puyuh jantan umur 1-5 minggu yang dibagi menjadi 4 kelompok perlakuan dengan taraf pemberian tepung biji karet fermentasi (FRSM) menggunakan ragi fermentasi yang berbeda yaitu R0= pemberian pakan tanpa FRSM (kontrol), R1= pemberian FRSM 4%, R2= pemberian FRSM 8%, dan R3= pemberian FRSM 12%. Masing-masing perlakuan diulang sebanyak 5 kali sehingga diperoleh 20 unit yang masing-masing unit berisi 13 ekor. Parameter yang diamati adalah konsumsi pakan, pertambahan bobot badan, konversi pakan, dan produksi karkas. Proses fermentasi dengan ragi tempe menurunkan kadar kandungan asam sianida (HCN) biji karet berkurang dari 158,64 ppm menjadi 17,84 ppm Hasil pengamatan menunjukkan penambahan tepung biji karet fermentasi pada pakan tidak memberikan pengaruh yang nyata (P>0,05) terhadap konsumsi pakan, mempertahankan pertambahan bobot badan, konversi pakan, bobot akhir badan, bobot karkas, dan persentase karkas. Kesimpulan penelitian ini adalah penambahan tepung biji karet yang difermentasi (FRSM) hingga 12% tidak mengganggu kinerja pertumbuhan dan hasil karkas puyuh.

Kata Kunci: Asam Sianida, Fermentasi, Biji Karet, Ragi Tempe, Karkas Puyuh

ABSTRACT

Hertamawati RT, Suryadi U, Prasetyo AF, Rahmasari R, Imam S, Asrianto N. 2024. Growth response and carcass yield of male Japanese quail-fed diets contained fermented rubber (*Hevea brasiliensis*) seed meal. JITV 29(4):221-226. DOI: http://dx.doi.org/10.14334/jitv.v29i4.2450.

This paper discusses the previous research on the use of fermented rubber seed meal using tempeh yeast (Rhizopus oligosporus) (FRSM) given to male quail from 1 to 5 weeks of age on the growth performance and carcass production. The research used a Completely Randomized Design (CRD) experimental method using about 260 male quail aged 0-5 weeks divided into 4 treatment groups with the level of giving fermented rubber seed meal (FRSM) using different fermented yeast, namely R0= feeding without FRSM (control), R1= feeding of 4% FRSM, R2 = feeding of 8% FRSM, and R3= feeding of 12% FRSM. Each treatment was repeated 5 times, making 20 units of 13 male quails. The parameters observed were feed consumption, body weight gain, feed conversion, and carcass production. Rubber seed fermentation in this research showed that rubber seeds' cyanide acid (HCN) content was reduced from 158.64 ppm to 17.84 ppm. The experimental results showed that adding fermented rubber seed meal to the diets did not decrease feed consumption or prevent weight gain, feed conversion, final body weight, carcass weight, and carcass percentage. This research concluded that adding fermented rubber seed meal up to 12% did not harm male quail's growth performance and carcass yield.

Key Words: Cyanide Acid, Fermentation, Rubber Seed, Tempeh Yeast, Quail Cascass

INTRODUCTION

The nutritional requirements for the development of quail are high, especially for the fulfillment 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 (Hertamawati et al., 2019). The protein source that is often used in commercial feed is fish meal. The relatively high 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 have been researched as an alternative raw material suitable for use as a protein source

substitute on layers (Lu et al. 2021), broilers (Aguihe et al. 2017), chickens (Syahruddin et al. 2016), and ducks(Boye et al. 2019). The advantage of rubber seed flour, which is produced from the seeds of the rubber plant, is that it is the most widely grown plantation crop in Indonesia, so its availability in large quantities is relatively guaranteed.

Previous researchers have found that *Hevea brasiliensis* dry seeds contain 17-25% protein (Oluodo et al. 2018); 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 (Udo et al. 2018). Additionally, other research (Syamsunarno et al. 2014) 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 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 (Oyewusi et al. 2007). 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 (Agbai et al., 2021). The content of rubber seed hydrocyanic acid is 24.89 % (Udo et al. 2018), similar to cassava cyanic acid (Montagnac et al. 2009). Fresh rubber seeds contain 1,200 ppm of HCN and 27 ppm of rubber seed cake meal (Agbai et al. 2021).

Rubber seed processing using fermentation technology is one way to reduce HCN content (Syamsunarno et al. 2014). Fermentation can enhance the digestibility of feed ingredients by breaking down complex substances through enzymes produced by fermenting microbes (Oluodo et al. 2018), (Novita et al. 2019). 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 (573.72 ppm to 30.75 ppm) (Syahruddin et al. 2016). 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 (Fadhilah, 2018). The fungus *Rhizopus sp.* contained in tempeh yeast can help hydrolyze the substrate, making it simpler and easier to absorb in the digestive tract.

Limited research has been done on using fermented rubber seed meal in quail diets. This study evaluated how incorporating fermented rubber seed meal, treated with tempeh yeast, affects male quails' growth and carcass yield.

MATERIALS AND METHODS

The source and processing methods of rubber seeds

The rubber seeds utilized in the study were sourced from a rubber plantation 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 (Rachmawan 2008). Subsequently, the rubber seeds are steamed for 10 minutes and 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.

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. No. 02/PL17.4/PG/2024, September 4th 2023. The experiment involved 260 male day-old quails. Following a completely randomized design, the birds were randomly assigned to one of four dietary treatment groups, each consisting of five replicates containing thirteen birds. The birds were reared in a quail battery cage (50x50x16 cm). Each battery cage is equipped with one long trough feeder and manual drinker. The experiment spanned 35 days, during which each group had unrestricted access to its designated diet and clean water.

Experimental diets

Four distinct feed rations were formulated to fulfill the nutritional requirements of growing quails. The R0 diet, the negative control, did not contain any tempeh rubber seed meal (FRSM). In contrast, the R1 diet, the positive control, incorporated 5% FRSM. The R2 and R3 diets included 10% and 15% FRSM, respectively; all diets were formulated to similar levels of calculated ME and CP(Abbas et al. 2016), as outlined in Table 1. The specific nutrient composition of the fermented rubber seed meal is presented in Table 2. The quails were given diets in the morning and afternoon.

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

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
Fermented rubber seed meal (FRSM)(%)	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
Calcium (%)	1.14	1.16	1.34	1.19
Phosphor (%)	0.73	0.76	0.74	0.77

*PT. Wonokoyo Jaya Corp; **ME, Ca & P content based the calculation; ***proximate analysis

Table 2. Nutrient of fermented rubber seed meal based on proximate analysis

Nutrient content	Total
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

the end of the research (35 days old), the percentage of carcasses were collected by comparing the carcass weight with the live weight.

Statistical analysis

The data were examined using Analysis of Variance (ANOVA) within a fully randomized design. Duncan's multiple range test (DMRT) was utilized to pinpoint differences among the treatment groups.

RESULTS AND DISCUSSION

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% fermented rubber seed meal (FRSM) to their diet did not significantly affect their feed intake, body weight gain, or feed conversion ratio ($P>0.05$).

Dietary fermented rubber seeds meal showed no significant influence on quail feed intake and palatability. According to the opinion (Lamichhane et al. 2018), the organoleptic, such as taste, smell, and texture, reflects the palatability. The findings of this study are consistent with those reported by (Olawoyin 2010) that feeding 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 (Hertamawati et al. 2019), that quail 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 antinutrient substances such as hydrogen

cyanide (HCN), which are toxic and harmful to the quail. The alternative to reducing these toxins could also be soaked and fermented (Matho et al. 2021). This research showed that fermentation with tempeh yeast reduced HCN levels from 158.64 ppm to 17.85 ppm. Quail and other poultry have some capacity to detoxify HCN through the enzymatic conversion of cyanide to thiocyanate, which is then excreted. However, this mechanism has a limit, and if the HCN content exceeds a certain threshold, the detoxification capacity is overwhelmed, leading to toxicity symptoms. The safe limit of HCN in poultry feed is generally recommended to be below 100 mg/kg to avoid adverse effects on carcass quality and bird health (Devi and Diarra 2021). According to (Aguihe et al. 2017), rubber seed meal treated with soaking and fermentation processes will reduce the HCN content in rubber seeds. The increase in body weight was related to feed intake (Nnadi et al. 2022), an important factor affecting body weight gain.

The feed conversion value with FRSM was higher than the control feed, which indicates a decrease in feed efficiency. Several factors affect feed conversion, namely digestibility, body weight gain, and feed consumption (Varkoohi et al. 2010), which stated that the factors affecting feed conversion include digestibility of feed quality, body weight gain, and feed intake.

Carcass yield

Table 4 illustrates the average body weight, carcass weight, and carcass percentage. According to the variance analysis, adding fermented rubber seed meal (FRSM) 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 g/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 (Novita et al. 2019; Kouassi et al. 2020).

This study demonstrated that the administration of fermented rubber seeds did not affect the carcass quality of quail, as the HCN content in the rubber seeds had decreased and was digestible by the quail. Reducing HCN levels in rubberseed-based feeds through fermentation can mitigate the adverse effects on carcass quality, leading to healthier, more robust birds with better meat yield and texture (Oluodo et al. 2018). The average carcass weight obtained ranged from 107.39 to 111.77 g/bird. The quality and production of carcasses are closely related to live weight. The live weight of quail in this study was higher than the results of research conducted by (Karim 2015), which stated an average live weight of 131 to 139 grams/bird. Factors affecting carcass weight include live weight, species, genetics, and the same slaughter age. The study by (Basri and Sulastri 2019) also concluded that including rubber seed meal in the diet did not significantly affect 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 by (Nnadi et al. 2022) and (Karim 2015), 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, and the rate of the carcass begins from the development rate demonstrated by the increment in body weight, which influences the coming about of live weight (Sabow 2020).

Table 3. Growth performance of quail feeding with different levels of fermented rubber seed meal

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

FRSM= fermented rubber seed meal; R0= feeding without FRSM (control); R1= feeding of 4% FRSM; R2 = feeding of 8% FRSM; R3= feeding of 12% FRSM

Table 4. Carcass yield of quail feeding with different levels of fermented rubber seed meal

Feeding Treatment	Final body weight (g/bird)	Carcass weight (g/bird)	Percentage of Carcass (%)
R0 (0% FRSM)	160.4±4.62	107.39±4.53	66.94±1.57
R1 (4% FRSM)	160.4±4.72	110.02±5.08	68.58±2.14
R2 (8% FRSM)	161.0±6.16	109.45±5.96	67.97±2.42
R3 (12% FRSM)	160.6±3.29	111.77±3.55	69.59±0.94

FRSM= fermented rubber seed meal; R0= feeding without FRSM (control); R1= feeding of 4% FRSM; R2 = feeding of 8% FRSM; R3= feeding of 12% FRSM

CONCLUSION

It can be concluded that the male quail-fed diets containing fermented rubber seed meal (FRSM) up to 12% did not reduce growth performance and carcass yield.

ACKNOWLEDGEMENT

PNBP supported this research via an applied research grant project from Politeknik Negeri Jember.

REFERENCES

Abbas Y, Sahota AW, Akram M, Javed K, Younus M, Mehmood S, Ahmad S, Jatoi AS, Sciences A, Sciences A. 2016. Effect of different dietary lysine regimens on the growth performance and economic efficiency of Japanese quails. 26:315–319.

Abiola Oluodo L, Huda N, Fay Komilus C. 2018. Potential utilization of rubber seed meal as feed and food. IJET. 7:64–71. DOI:10.14419/ijet.v7i4.43.25821.

Agbai CM, Olawuni IA, Ofoedu CE, Ibeabuchi CJ, Okpala COR, Shorstkii I, Korzeniowska M. 2021. Changes in antinutrient, phytochemical, and micronutrient contents of different processed rubber (*Hevea brasiliensis*) seed meals. PeerJ. 9. DOI:10.7717/PEERJ.11327/SUPP-1.

Aguihe PC, Kehinde AS, Ospina-rojas CI, Murakami AE. 2017. Evaluation of processing methods of rubber (*Hevea brasiliensis*) seed meal for use as a feed ingredient for broiler chickens. J Poult Res. 14:20–27.

Basri H, Sulastri MP. 2019. Percentage of carcass and internal organs of Japanese quail after given organic feed. biogenesis: J Ilm Biol. 7:87–93. DOI:10.24252/bio.v7i2. 9315.

Boye A, Dofara DS, Moussa K. 2019. Effect of the rate of incorporation of rubber seed cake (*Hevea brasiliensis*) on the zootechnical performance of local ducks (*Cairina moschata Linnæus*, 1758) in semi intensive breeding in Cote d'Ivoire. IJASRE. 5:170–176. DOI:10.31695/IJAS RE.2019.33142.

Devi A, Diarra SS. 2021. Factors affecting the utilization of cassava products for poultry feeding [Review]. EJVS. 52:387–403. DOI:10.21608/EJVS.2021.50090.1204.

Fadhilah, Dhafir F, Masrianih. 2018. Pengaruh lama waktu fermentasi terhadap kandungan protein olahan tempe biji kamonji (*Artocarpus camansi*) dan pemanfaatannya sebagai media pembelajaran. J Biol Sci Educat. 6:370–374.

Hertamawati RT, Soedjarwo E, Sjofjan O, Suyadi S. 2019. Implication of feed restriction during growth period on the growth hormone profiles and morphology ovary of quail hen (*Coturnix coturnix japonica*). J Indones Trop Anim Agric. 44:415. DOI:10.14710/jitaa.44.4.415-422.

Hertamawati RT, Soedjarwo E, Suyadi, Sjofjan O. 2019. Reproductive performance of Japanese quail hens (*Coturnix coturnix japonica*) fed with feed restriction regimes during growth period. 39:163–166.

Karim Z. 2015. Effect of the replacement of soybean meal by rubber seed meal on growth, economics and carcass characteristics of broiler. Iran J Appl Anim Sci. 5:919–925. DOI:10.13140/RG.2.2.33123.12326.

Kouassi GF, Koné GA, Good M, Assidjo NE, Kouba M. 2020. Effect of *Hevea brasiliensis* seed meal or Euphorbia heterophylla seed supplemented diets on performance, physicochemical and sensory properties of eggs, and egg yolk fatty acid profile in guinea fowl (*Numida meleagris*). Poult Sci. 99:342–349. DOI:10.3382 /ps/pez500.

Lamichhane U, Regmi S, Sah R. 2018. Changes in palatability of poultry feed using garlic, ginger and their combination. Acta Sci Agric. 2:68–72.

Lu Q, Chen P, Chai Y, Li Q, Mao H. 2021. Effects of dietary rubber seed oil on production performance, egg quality, and yolk fatty acid composition of Hy-Line Brown layers. 34:119–126. DOI:10.5713/ajas.19.0832.

Matho A, Aimee MC, Mouchili M, Mube KH, Fualefac HD, Fonteh F, Teguia A, Tchoumboue J. 2021. The effects of processed rubber (*Hevea brasiliensis*) seed meal on the chemical composition of ration, feed intake, and nutrient digestibility in rabbits (*Oryctolagus cuniculus*). OJAFR. 11:95–102. DOI:10.51227/ojafr.2021.16.

Montagnac JA, Davis CR, Tanumihardjo SA. 2009. Processing techniques to reduce toxicity and antinutrients of cassava for use as a staple food. Compr Rev Food Sci Food Saf. 8:17–27. DOC:10.1111/J.1541-4337.2008.00064.X.

Nnadi GL, Simeon–ahaotu VC, De los Ríos-Escalante P, Ahaotu EO. 2022. Replacement level of rubber seed cake for soybean meal on the growth of Japanese quail. Brazilian J Biol. 82:1–9. DOI:10.1590/1519-6984.2432 42.

Novita R, Herlina B, Permata L. 2019. Level pemberian tepung biji karet terhadap produksi dan bobot telur burung puyuh (*Coturnix coturnix Japonica*). J Biosilampari: J Biol. 1:87–94. DOI:10.31540/biosilampari.v1i2.248.

Olawoyin OO. 2010. Effects of rubber (*Hevea brasiliensis* L) seen meal on the composition of quail (*Coturnix coturnix japonica*) eggs. Uniswa Res J Agric Sci Technol. 10. DOI:10.4314/uniswa-rjast.v10i2.53508.

Oyewusi PA, Akintayo ET, Olaofe O. 2007. The proximate and amino acid composition of defatted rubber seed meal. J Food Agric Environ. 5:115–118.

Rachmawan O. 2008. Pengaruh tingkat bungkil biji karet yang difermentasi dalam ransum terhadap konsumsi bahan kering, pertambahan bobot badan harian, efisiensi ransum, dan bobot potong domba jantan. J Indon Trop Anim Agric. 11.

Sabow AB. 2020. Carcass characteristics, physicochemical attributes, and fatty acid and amino acid compositions of meat obtained from different Japanese quail strains. Trop Anim Health Prod. 52:131–140. DOI:10.1007/S11250-019-01991-2.

Syahruddin E, Herawaty R, Azhar. 2016. Improving the quality of the leaves and seeds of rubber trees (*Hevea brasilliensis*) for poultry feed through various types of microbial biotechnology. PJN. 15:963–968. DOI:10.3923/pjn.2016.963.968.

Syamsunarno MB, Tri M, Sunarno D. 2014. Kajian biji karet (*Hevea brasiliensis*) sebagai kandidat bahan baku pakan ikan. JIPP . 3:135–142.

Udo MD, Ekpo U, Ahamefule FO. 2018. Effects of processing on the nutrient composition of rubber seed meal. JSSAS. 17:297–301. DOI:10.1016/J.JSSAS. 2016.06.001.

Varkoohi S, Babak MMS, Pakdel A, Javaremi AN, Zaghari M, Kause A. 2010. Response to selection for feed conversion ratio in Japanese quail. Poult Sci. 89:1590–1598. DOI:10.3382/PS.2010-00744.