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The Effect of Additional Fermented Coconut Dregs Using Tape Yeast as a Feed Ingredient on the Nutrient Intake and Performance of Starter Phase Laying Quails

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ABSTRACT

This study evaluated the effects of dietary inclusion of fermented coconut dregs (FCD) using tape yeast (Saccharomyces cerevisiae consortium) on the nutrient intake and growth performance of laying quails (Coturnix coturnix japonica) during the starter phase (0–4 weeks). A total of 200 day old quails with an average initial body weight of 7.46 g were randomly assigned to four dietary treatments based on a Completely Randomized Design with five replications (10 birds per replicate). The treatments consisted of a control diet without FCD (P0), and diets containing 7% (P1), 14% (P2), and 21% (P3) FCD. Results indicated that FCD incorporation did not significantly influence ($p > 0.05$) dry matter intake, crude protein intake, crude fat intake, total feed intake, or the feed conversion ratio (FCR). However, crude fiber intake increased significantly ($p < 0.05$) from 8.98 g (P0) to 17.03 g (P3) due to the high structural carbohydrate profile inherent to the byproduct. Concurrently, body weight gain (BWG) exhibited a pronounced reduction ($p < 0.05$) at the highest inclusion level, decreasing from 71.92 g in P0 to 59.95 g in P3. This growth depression is attributed to the physiological immaturity of the starter quail's digestive tract, where elevated fiber accelerates digesta transit time, restricts nutrient encapsulation, and compromises net energy assimilation. Although numerical trends showed an erosion in feed efficiency with an increasing FCR from 2.90 to 3.39, palatability remained uncompromised across all levels. In conclusion, while fermented coconut dregs serve as a viable alternative agro-industrial byproduct to reduce feed expenses, its inclusion in starter quail rations should be restricted to a maximum tier of 7% (P1) to prevent adverse effects on growth performance.

INTRODUCTION

Quail production has emerged as an important sector of the poultry industry, offering high-quality protein through both meat and egg production in a relatively short production cycle. However, the economic viability of quail farming faces significant challenges, particularly regarding feed costs, which constitute approximately 60-70% of total production expenses. The rising prices and periodic shortages of conventional feed ingredients, especially protein sources such as soybean meal, have prompted researchers to explore alternative feed ingredients that can reduce production costs while maintaining or improving bird performance (Hsiao et al. 2022).

Coconut (Cocos nucifera) byproducts represent a promising alternative feed resource, particularly in tropical regions where coconut processing generates substantial amounts of waste materials. Coconut drain, also known as coconut dregs or coconut residue, is a byproduct obtained from coconut milk extraction and coconut oil processing. This material is abundantly available and often underutilized, making it an attractive candidate for incorporation into poultry diets. However, raw coconut byproducts typically contain high levels of crude fiber (15-20%), moderate protein content (19-22%), and various antinutritional factors that limit their digestibility and nutritional value for monogastric animals such as poultry (Damry, Hatta, and Sundu 2020).

Fermentation technology offers a viable solution to improve the nutritional quality of coconut byproducts. Solid-state fermentation using selected microorganisms can enhance the nutritional profile of feed ingredients through several mechanisms: increasing crude protein content through microbial protein synthesis, reducing crude fiber and non-starch polysaccharides through enzymatic degradation, decreasing antinutritional factors, and producing beneficial metabolites such as organic acids, vitamins, and bioactive compounds (Amizar, Nur, and Huda 2022). Studies have demonstrated that fermentation of copra meal and coconut residues can increase crude protein content from 19.63% to 23.11% and reduce crude fiber from 16.00% to 11.63%, significantly improving the nutritional value of these materials (Damry, Hatta, and Sundu 2020). Tape yeast, a traditional Indonesian fermentation starter culture primarily containing microbial consortium dominated by S. cerevisiae, amylolytic molds, and lactic acid bacteria. This synergy yields a comprehensive enzyme profile, including cellulase, mannanase, and protease.

Despite the promising results obtained with fermented coconut products in broiler chickens and laying hens, limited research has been conducted specifically on laying quails (Coturnix coturnix japonica). Quails have distinct nutritional requirements and physiological characteristics compared to chickens, including faster growth rates, earlier sexual maturity, and different digestive tract morphology. The starter phase (0-3 weeks of age) is particularly critical for laying quails, as this period establishes the foundation for subsequent growth, development, and egg production performance. Adequate nutrition during the starter phase influences skeletal development, organ maturation, and the establishment of a healthy gut microbiome, all of which are essential for optimal laying performance.

The potential benefits of incorporating fermented coconut drain in quail starter diets include improved protein availability, enhanced energy utilization through reduced fiber content, better gut health through probiotic effects of residual Saccharomyces cerevisiae cells, and reduced feed costs through partial replacement of expensive conventional ingredients. Studies with other poultry species suggest that fermented coconut products can be safely included at levels of 5-20% in the diet without adverse effects on performance, and in some cases, with significant improvements in feed conversion ratio and body weight gain (Amizar, Nur, and Huda 2022). Therefore, this study was conducted to evaluate the effects of dietary inclusion of fermented coconut dregs using tape yeast on the nutrient intake and growth performance of laying quails during the starter phase.

MATERIALS AND METHODS

The equipment used in this study included cages, recording tools, thermometer, cleaning tools, feeders, drinkers, digital scales, stationery, plastic, and steamers. The materials used in this study consisted of 200 Day Old Quails (DOQ) with an average body weight of 7.46 g/bird, feed stuff, vitamins and medications, coconut dregs, tape yeast.

Fermented Coconut Dregs

The coconut dregs were steamed for 30 minutes, then spread on a tarpaulin and cooled. Finely ground tape yeast was sprinkled according to the predetermined dosage and mixed until homogeneous. The mixture was then placed into plastic bags and tied loosely (not too tightly). The fermentation process lasted for 4 days at room temperature. After 4 days, the fermentation process was completed. The product was then dried and stored. Once dry, it was ground to obtain a finer texture and turned into flour.

Coconut Dregs Fermentation

The coconut dregs were steamed for 30 minutes, then spread on a tarpaulin and cooled. Finely ground tape yeast was sprinkled according to the predetermined dosage and mixed until homogeneous. The mixture was then placed into plastic bags and tied loosely (not too tightly). The fermentation process lasted for 4 days at room temperature. After 4 days, the fermentation process was completed. The product was then dried and stored. Once dry, it was ground to obtain a finer texture and turned into flour.

Feed Treatments Management

In the first week, adaptation feed was provided. Feed treatments were administered in stages to achieve the appropriate levels of adaptation for each treatment. In the second to fourth weeks, treatment feeds were provided according to the composition and nutritional content of the feeds listed in Table 1. Treatment feeds were provided in the morning and evening. Feed provided, unconsumed feed remaining, and quail body weights were measured weekly.

Tabel 1. Feed ingredient and nutritional content of the feed treatment.

Feed Ingredients	Treatment			
	P0	P1	P2	P3
	(%)			
Yellow Corn	37,97	27,99	19,87	10,68
Rice Bran	4,99	7,97	9,32	11,68
Concentrate	27,87	27,87	27,64	27,47
Soybean meal	28,67	28,67	28,67	28,67
Premix	0,5	0,5	0,5	0,5
Coconut Dreg	0	7	14	21
Total	100	100	100	100
Feed Nutrient				
Crude protein*	27,51	28,24	27,18	28,77
Crude fat*	4,83	5,57	6,25	6,00
Crude fibre*	4,89	5,44	7,67	9,35
Dry mater**	87,9	89,9	89,4	89,4
EM (kcal/kg)**	2690	2850	2820	2740

Description: *Proximate Analysis in Brawijaya University Laboratory
**Proximate Analysis in Politeknik Negeri Jember Laboratory

Experimental Design and Data Collection

The method used in this study was a Completely Randomized Design (CRD) consisting of 4 treatments and 5 replications. Each treatment replication consisted of 10 quails. The treatments applied were:

P0 = 0% (control feed)
P1 = 7% fermented coconut dregs in the feed
P2 = 14% fermented coconut dregs in the feed
P3 = 21% fermented coconut dregs in the feed

Feed consumption and feed convertion data were collected and compiled to determine the average values over the four-week treatment period. Nutrient intake was subsequently calculated using the following formulas adapted from Karwanti et al. (2023):

$$\text{DMI (g)} = FI\ (g)\ x\ DM\ (\%)$$
$$\text{OMI (g)} = FI\ (g)\ x\ OM\ (\%)\ x\ DM\ (\%)$$
$$\text{CPI (g)} = FI\ (g)\ x\ CP\ (\%)\ x\ DM\ (\%)$$
$$\text{EEI (g)} = FI\ (g)\ x\ EE\ (\%)\ x\ DM\ (\%)$$
$$\text{CFI (g)} = FI\ (g)\ x\ CF\ (\%)\ x\ DM\ (\%)$$

Note: DMI = Dry Matter Intake, FI = Feed Intake, DM = Dry Matter, OMI = Organic Matter Intake, OM = Organic Matter, CPI = Crude Protein Intake, CP = Crude Protein, EEI = Ether Extract/Crude Fat Intake, EE = Ether Extract, CFI = Crude Fiber Intake, CF = Crude Fiber.

Statistical analysis

The data collected during the study were analyzed using a one-way analysis of variance (ANOVA) to evaluate the effects of fermented coconut dregs inclusion on nutrient intake and production performance. Significant differences among treatment means ($p \leq 0.05$) were further evaluated using Duncan's multiple range test. Statistical analyses were conducted using the Statistical Package for the Social Software Version 22 (SPSS, IBM Corp. NY, USA).

RESULTS AND DISCUSSION

Nutrient Intake of Starter Phase Quail

The effects of incorporating fermented coconut dregs (FCD) into the diets of starter phase quail on nutrient intake are summarized in Table 2. Statistical analysis revealed that the inclusion of FCD did not exert a significant influence ($p > 0.05$) on crude protein intake, crude fat intake, and dry matter intake (DMI). However, a significant increase ($p < 0.05$) was observed in crude fiber intake as the levels of FCD advanced from P0 to P3. This trend is primarily attributed to the naturally elevated fiber profile inherent in the coconut dregs, which persisted despite the fermentation process. Consistent with prior findings in poultry nutrition, elevated dietary fiber levels often correlate with increased fiber consumption without necessarily hindering the overall utilization of other essential nutrients [wp lokaoinarsari].

Table 2: Effects of fermented coconut dregs on nutrient intake of starter phase quail

Treatments	Crude Protein Intake	Crude Fiber Intake	Crude Fat Intake	Dry Mater Intake
P0	50,52 ± 0,04	8,98^{a} + 0,31	8,87 + 0,01	183,64 + 0,28
P1	53,14 + 0,02	10,23^{ab} + 0,06	10,48 + 0,15	188,17 + 0,03
P2	49,96 + 1,01	14,10^{ab} + 0,18	11,48 + 0,26	183,83 + 0,40
P3	52,41 + 0,52	17,03^{b} + 0,02	10,93 + 0,08	182,18 + 1,01

Different letters in the same column mean a statistical difference at $p \leq 0.05$

The systematic rise in crude fiber intake, culminating in the highest value under the P3 treatment (17.03 + 0.02 g), is directly attributed to the high structural carbohydrate profile inherent

to coconut dregs. Although the fermentation process typically targets the degradation of complex cell wall components such as cellulose and hemicellulose via microbial enzymatic activities, the cumulative fiber content remained elevated in diets with higher FCD substitution. Analisis regresi polinomial ortogonal lebih lanjut menunjukkan bahwa peningkatan proporsi limbah ampas kelapa dalam ransum memberikan pengaruh linear yang signifikan terhadap total asupan serat kasar (Fati and Malvin 2023; Mulaudzi, Mnisi, and Mlambo 2022). The statistically uniform dry matter and crude protein intakes imply that the palatability of the feed was preserved despite the integration of agro-industrial byproducts, demonstrating that microbial fermentation effectively mitigated potential off-flavors or texture degradation. These results align with previous studies in which the substitution of alternative fiber sources did not adversely impact the primary nutrient digestibility or physiological performance of avian species (Nuriyasa, Puja, and Puger 2022; Unnawong, Suriyapha, and Chankaew 2024).

Growth Performance of Starter Phase Quail

The production performance parameters, encompassing feed intake, body weight gain (BWG), and feed conversion ratio (FCR), are displayed in Table 2. The statistical evaluations indicated that while feed intake and FCR did not shift significantly across the groups, the body weight gain exhibited a pronounced reduction ($p > 0.05$) as FCD levels peaked in the P3 treatment group. The significant decline in body weight gain under the P3 treatment group (59.95 $\pm$ 5.48 g) compared to the control group P0 (71.92 $\pm$ 10.01 g) reveals crucial physiological dynamics during the starter phase of the quail. At this early developmental juncture, the gastrointestinal tract of the quail is structurally immature and lacks a fully robust endogenous enzymatic repertoire needed to process elevated levels of dietary crude fiber. Consequently, the increased fiber concentration at higher inclusion levels may accelerate digesta transit time, thereby reducing the residence period available for nutrient absorption and resulting in suboptimal growth performance (Jha and Mishra 2021; Kusumorini et al. 2021). This phenomenon is consistent with observations in other poultry studies, where increased fiber density can interfere with nutrient digestibility, potentially prompting compensatory consumption patterns or limiting the net energy available for tissue accretion (Mnisi et al. 2021; Rasool et al. 2023)

Table 3: Effects of Fermented Coconut Dregs on Growth Performance of Starter Phase Quail

Treatments	Feed Intake	Body Weight Gain	Feed Convertion Ratio
P0	208,93 + 10,27	71,92^{a} + 10,01	2,9 + 0,30
P1	209,32 + 18,30	70,25^{a} + 7,13	2,97 + 0,12
P2	205,63 + 12,90	63,4^{ab} + 8,04	3,24 + 0,22
P3	203,79 + 13,97	59,95^{b} + 5,48	3,39 + 0,11

Different letters in the same column mean a statistical difference at $p \leq 0.05$

As established by the nutrient intake profiles, the crude fiber intake increased significantly up to 17.03 g in P3. High dietary fiber accelerates digesta passage rate and physical bulk within the gut lumen, which restricts the time available for thorough nutrient digestion and subsequent absorption across the intestinal epithelium.Consequently, even though the total feed and dry matter intakes remained steady across all treatments, the actual bio-availability and metabolic utilization of crucial nutrients specifically amino acids and energy fractions were likely compromised at higher FCD inclusion rates. This drop in net nutrient assimilation directly explains the compromised body weight gain observed in P2 and P3 groups. Furthermore, the numerical upward trend in the Feed Conversion Ratio from 2.90 (P0) to 3.39 (P3) strongly supports this narrative, signaling an erosion in feed efficiency as fiber levels escalate. This observation aligns with reports that birds fed high-fiber diets often exhibit worse feed conversion ratios because the

bulkiness of the diet limits energy absorption without necessarily reducing total feed intake (Bhuiyan et al. 2021).

The findings underscore that while fermented coconut dregs serve as a viable alternative feed resource, its inclusion in starter-stage quail rations must be restricted to lower tiers (ideally matching P1 protocols) to circumvent growth depression triggered by fiber-induced digestive limitations. Furthermore, the inclusion of such fibrous ingredients at higher concentrations may physically encapsulate essential nutrients, creating a barrier that restricts the efficacy of endogenous digestive enzymes (Wang et al. 2024). Hal ini sejalan dengan temuan bahwa kelebihan serat larut dapat membentuk penghalang nutrisi pada permukaan kimus yang menghambat akses enzim pencernaan, sehingga menurunkan efisiensi metabolisme zat gizi secara keseluruhan (Li et al. 2022).

CONCLUSIONS

The inclusion of coconut pulp fermented with tape yeast at levels up to 21% does not compromise feed palatability; however, it significantly increases crude fiber intake, resulting in reduced weight gain in starter-phase quail. Fermented coconut pulp can serve as an alternative feed ingredient, with a recommended maximum inclusion level of 7%.

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AUTHOR CONTRIBUTION

NHDL: Conceptualization, methodology, and original draft preparation. NA: Data curation, formal analysis, and investigation. DS: Supervision, review, and editing of the final manuscript.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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