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Jack Bean (*Canavalia ensiformis*) Meal Inclusion and Lactic Acid Bacteria Supplementation on Performance of The IPB D1 Chickens

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ABSTRACT

This study investigates the effects of including jack bean (*Canavalia ensiformis*) meal in the ration and lactic acid bacteria (LAB) supplementation on the performance and carcass yield of IPB D1 chickens. Jack bean meal (JBM) contains a high-energy, protein-rich feed ingredient that can substitute soybean meal, though it contains antinutrients such as hydrocyanic acid. Pre-treating jack beans through soaking and peeling reduces these antinutrients, allowing JBM to replace up to 20% of the diet. The inclusion of exogenous enzymes like protease can further enhance nutrient absorption and broiler health. The study involved 240 IPB D1 chickens, divided into four groups: control feed without LAB (J0L0), control feed with LAB (J0L1), treatment feed without LAB (J1L0), and treatment feed with LAB (J1L1). Feed intake, body weight gain (BWG), and feed conversion ratio (FCR) were measured weekly from weeks 3 to 9, and carcass yields were evaluated at the end of the study. Results showed significant variations ($p<0.05$) in weekly feed intake, BWG, and FCR across the treatments. Chickens fed JBM had lower ($p<0.05$) feed intake and BWG but these improved with LAB supplementation. FCR values improved significantly ($p<0.05$) with LAB supplementation in both control and treatment feeds. Carcass yield analysis indicated that LAB supplementation led to higher ($p<0.05$) final body weight and carcass yield, while JBM inclusion resulted in lower values ($p<0.05$). The study concludes that while JBM can negatively affect chicken performance due to antinutrients, LAB supplementation can mitigate these effects, enhancing both performance and carcass yield. In addition, probiotics are beneficial in poultry diets, counteracting antinutritional factors in feed ingredients like Jack bean meal.

Key words: antinutrient, chicken health, probiotic, soybean meal

ABSTRAK

Penelitian ini mempelajari efek dari penambahan tepung kacang koro (*Canavalia ensiformis*) dalam ransum dan suplementasi bakteri asam laktat (BAL) pada performa dan hasil karkas ayam IPB D1. Tepung kacang koro mengandung bahan pakan berenergi tinggi dan kaya protein yang dapat menggantikan tepung kedelai, meskipun mengandung antinutrien seperti asam hidrosianat. Perlakuan awal terhadap kacang koro melalui perendaman dan pengupasan mengurangi antinutrien ini, memungkinkan tepung kacang koro menggantikan hingga 20% dari ransum. Penambahan enzim eksogen seperti protease dapat lebih meningkatkan penyerapan nutrien dan kesehatan broiler. Studi ini melibatkan 240 ayam IPB D1, dibagi menjadi empat kelompok: pakan kontrol tanpa BAL (J0L0), pakan kontrol dengan BAL (J0L1), pakan perlakuan tanpa BAL (J1L0), dan pakan perlakuan tdengan BAL (J1L1). Asupan pakan, pertambahan berat badan (BWG), dan rasio konversi pakan (FCR) diukur setiap minggu dari minggu ke-3 hingga ke-9, dan hasil karkas dievaluasi pada akhir studi. Hasil penelitian menunjukkan perbedaan signifikan ($p<0{,}05$) pada konsumi pakan mingguan, BWG, dan FCR di seluruh perlakuan. Ayam yang diberi tepung kacang koro memiliki konsumsi pakan dan pertambahan bobot badan yang lebih rendah tetapi meningkat dengan suplementasi BAL. Nilai FCR menurun secara signifikan ($p<0{,}05$) dengan suplementasi BAL pada pakan kontrol maupun perlakuan. BAL menghasilkan bobot badan akhir dan hasil karkas yang lebih tinggi dibanding tanpa peberian BAL, sedangkan penambahan tepung kacang koro menghasilkan nilai yang lebih rendah. Penelitian ini menyimpulkan bahwa meskipun tepung kacang koro dapat berdampak negatif pada kinerja ayam karena antinutrien, suplementasi LAB dapat mengurangi efek ini, meningkatkan kinerja dan hasil karkas. Selain itu, probiotik bermanfaat dalam diet unggas, mengatasi faktor antinutrisi dalam bahan pakan seperti bungkil kacang jack.

Kata kunci: anti nutrisi, bungkil kedelai, kesehatan ayam, probiotik, subtitusi

INTRODUCTION

Jackbean (*Canavalia ensiformis*) is a promising local feed ingredient rich in energy and protein, suitable as a substitute for soybean meal in rations (Mutia *et al*. 2024). However, jack beans contain antinutrients such as hydrocyanic acid at 21 – 51 ppm (Alifianty *et al*. 2023), which can limit their use. Other antinutrients like trypsin inhibitors, lectins, haemagglutinin, and phytates, are well known for their protein-binding activities (Arise *et al*. 2022).

Jackbeans, rich in phenolic compounds and flavonoids, are easier to cultivate and abundant in Indonesia, making them a promising option for feed substitution (Yusuf *et al*. 2022; Sutedja *et al.* 2022). Although they contain anti-nutritional substances pre-treatment methods can mitigate these risks. Processing by soaking Jack beans for 3 hours and peeling them effectively reduces HCN content. This processed Jack Bean Mmeal can replace soybean meal up to 10% without affecting vital organs, digestive organs, immune organs, and intestinal villi histology (Alifianty *et al.* 2023). Additionally, supplementing with exogenous enzymes like protease can enhance broiler health profile (Mahardhika *et al*. 2021)

Using antibiotics in feed has negative effects on livestock, including residues in meat and other animal products, which can harm consumer health (Arsène *et al*. 2022). To overcome this problem, an alternative agent that can be used is a probiotic, such as lactic acid bacteria (LAB). Probiotics LAB have various beneficial characteristics (Kaya et al. 2022). Probiotics can help reduce the negative effects of antinutrients by increasing nutrient availability, promoting digestive enzyme production, and producing antimicrobial substances, thus improving livestock digestive health (Sjofjan *et al*. 2021). In addition, Sari & Akbar (2019) reported that using LAB in drinking water could enhance broiler performance including better feed intake, body weight gain, and feed conversion ratio.

IPB D1 integrates rapid-growth genes from broiler chickens, making up 25% of its genetic composition, through a crossbreeding program that includes three local chicken lineages: Kampung, Pelung, and Sentul, each contributing 25% (Habib *et al*. 2020). This selective breeding initiative was designed to address the slow growth rate typical of native breeds. Indigenous chickens are appreciated for their taste, resistance to diseases, and adaptability to local feed (Siddiqui *et al*. 2024).
Previous studies have reported that IPB D1 chickens have achieved accelerated growth, reaching a slaughter weight of 1.18-1.36 kg when fed high levels of protein and metabolizable energy (21%, 2950 kcal/kg), and 0.967-1.17 kg when fed low-level of protein and metabolizable energy (17%, 2689 kcal/kg) at 12 weeks of age (Habib *et al*. 2020). This achievement (1.18-1.36 kg with high levels of protein and metabolizable energy) surpasses the weights of local chickens (1.04-1.07 kg) as reported by Nurhayu *et al.* (2021). Additionally, IPB D1 chickens demonstrate the ability to assimilate local feed ingredients as their primary source of nutrition while maintaining health (Khairati *et al*. 2024).

This study aims to investigate the inclusion of Jack Bean Meal in diets and Lactic Acid Bacteria supplementation in drinking water on the weekly performance of IPB D1 chickens and carcass yield.

METHODS

Materials

The study involved 240 IPB D1 chickens aged 1 to 63 days. During days 1-14, the chickens received commercial pre-starter broiler rations, and from day 15 to 56, they were given treatment diets. The Jack bean meal used in the study had its nutritional composition detailed in Table 1. The Jack beans were first soaked for 3 hours. After drying in an oven at 60°C, they were ground and added to the feed mixture according to the treatment. Table 2 shows the composition of the treatment diet, which included 20% Jackbean meal for both control and experimental groups. Probiotics sourced from the Center for Applied Zoology Research, National Research and Innovation Agency (BRIN, Bogor) were administered via drinking water, containing Lactobacillus plantarum type lactic acid bacteria at a concentration of 10^7 CFU mL^{-1}. The treatments were categorized as follows: J0L0 (control feed without LAB), J0L1 (control feed with LAB), J1L0 (treatment feed without LAB), and J1L1 (treatment feed with LAB).

Chicken Rearing

Chicken rearing was conducted for 9 weeks in the semi-close house system. Day-old chicks (DOC) were placed in each cage, accommodating 10 chickens per cage. During the initial 1-2 weeks, commercial feed was provided and from weeks 3 to 9, the treatment feed was applied. The feed and the drinking water were provided *ad libitum*, with the volume measured before and after provision.

Chicken Performance and Organs

Observations of IPB D1 chicken performance involved 3 – 9 weeks of assessing feed intake, weight gain, and feed conversion. Additionally, the carcass yields were evaluated at 9 weeks of age.

Table1 Nutrient content of used Jack bean meal

Chemical content	Value
Cyanide acid, ppm	134.25
Dry matter, %	89.69
Crude ash, % DM	3.08
Crude protein, % DM	33.36
Ether extract, % DM	1.80
Crude fiber, % DM	9.27
Nonfiber carbohydrate, % DM	52.50

Table 2 Ingredient and nutrient content of experimental diets

Ingredient (%)	Control	Treatment
Yellow corn	59.0	52.7
Rice bran	6.55	5
Corn gluten meal	6.5	6
Soybean meal	16.5	5.5
Meat and bone meal	6	5.5
Jack bean meal	0	20
Crude palm oil	3	3
CaCO3	0.80	0.45
NaCl	0.20	0.2
Premix	0.50	0.75
DL-Methionine	0.45	0.45
Lysin	0.40	0.35
Tryptophan	0.10	0.10
Total	100	100
Nutrient content		
Cyanide acid, ppm	0	41.42
Dry matter, %	89.77	89.53
ME (kcal kg^{-1})	3004.95	3102.91
Crude protein, %	23.41	23.17
Ether extract, %	6.56	6.45
Crude fiber, %	5.36	5.58
Lysine, %	1.21	0.98
Methionine, %	0.75	0.68
Ca, %	0.83	0.98
P avail., %	0.41	0.47
Na, %	0.18	0.19
Cl, %	0.19	0.20

Noted: $CaCO_3$= Calcium Carbonate, NaCl= Natrium Chlorida, Ca = Calcium, P= Phosporus, Na= Natrium, Cl= Chlorida.

Data Analysis

To assess the efficacy of the four treatments, a Completely Randomized Design (CRD) with six replicates was utilized for each treatment. Subsequently, the collected data was analyzed using Analysis of Variance (ANOVA) software, specifically SPSS Statistics for Windows, Version 25.0. Upon detecting significant differences, a Tukey post hoc test was conducted to delve deeper into the variations

RESULT AND DISCUSSION

IPB D1 Chicken Performance

The performance metrics of IPB D1 chickens, including feed intake, body weight gain (BWG), and feed conversion ratio (FCR), are detailed in Table 3. The results indicate that treatments involving 20% Jack bean meal inclusion and prebiotic LAB supplementation in drinking water showed significant variation ($p < 0.05$) across all parameters in every-week measurement from week 3 to week 9.

During the entire rearing period from weeks 3 to 9, feed intake ranged from 772 to 894 grams per chicken in week 3 to 2785 to 3051 grams per chicken in week 9. The highest feed intake ($p<0.05$) was found in the control feed with prebiotic LAB supplementation (J0L1). The inclusion of 20% Jackbean meal in feed (J1L0, J1L1) resulted in a significant decrease ($p<0.05$) in feed intake at all weekly measurements compared to the control feed (F0J0 and F0J1). However, feed intake appeared to increase ($p<0.05$) with prebiotic LAB supplementation in the drinking water, both in the control (J0L1) and treatment feed (J1L1). These variations in feed intake could be attributed to the presence of antinutrients such as cyanide acid and the effects of prebiotic LAB.

The decrease in feed intake due to Jack bean meal inclusion aligns with other studies on both broiler chickens (Mahardhika *et al.* 2023) and layer chickens (Fikriandi *et al.* 2024), which have attributed this effect to antinutrients present in Jack beans. These antinutrients, such as trypsin inhibitors and cyanide acid, interfere with nutrient absorption and metabolism, leading to reduced feed efficiency.

The negative effects of antinutrients in Jack bean meal in this experiment were mitigated by prebiotic LAB supplementation in drinking water, as indicated by the increased ($p<0.05$) feed intake in treatment feed (J1L1). Prebiotic LAB helps improve gut health and nutrient absorption, counteracting the adverse effects of antinutrients (Julendra *et al.* 2021; Rehman *et al.* 2020). Additionally, processing treatments such as soaking and peeling (Alifianty *et al.* 2023) and enzyme addition (Mahardhika *et al.* 2023) have been reported to minimize the impact of antinutrients on broiler chicken feed intake, making Jack bean meal a more viable feed ingredient.

Regarding body weight gain (BWG), the research indicated significant variation ($p < 0.05$) in BWG across treatments during the weekly measurements from weeks 3 to 9. The BWG ranged from 142 to 180 g $bird^{-1}$ $week^{-1}$ in week 3 and from 686 to 873.89 g $bird^{-1}$ $week^{-1}$ in week 9.

Similar to feed intake, the highest BWG was found in the chicken-fed control in combination with prebiotic LAB in drinking water (J0L1). Compared to the control feed (J0L0), the BWG decreased ($p < 0.01$) due to the addition of 20% Jack bean meal in the feed (J1L0 and J1L1). Conversely, prebiotic LAB supplementation significantly improved ($p < 0.01$) BWG, for both control and treatment feed (J0L1 and J1L1). The decrease in BWG might be attributed to the reduced feed intake due to antinutritional factors in the ration fed to the IPB D1 chickens. Antinutrients, such as trypsin inhibitors and cyanogenic glycosides, can interfere with nutrient absorption and metabolism, leading to poorer growth performance.

The effect of Jack bean meal inclusion in the chicken ration has been reported with varying results. Alifianty *et al.* (2023) and Sudarman *et al.* (2018) found no differences in the BWG of broiler chickens both fed a control ration and treatment rations containing Jack bean meal. On the other hand, a decrease in BWG due to

Table 3 Growth performance of IPB D1 chicken at week 3 - 9

Parameter	J0L0	J0L1	J1L0	J1L1
		Week 3		
FI, g bird^{-1}	795.22 ± 38.01^{b}	894.72 ± 34.98^{a}	772.00 ± 31.82^{b}	780.83 ± 39.99^{b}
BWG, g bird^{-1}	168.72 ± 10.47^{b}	180.01 ± 10.25^{b}	142.17 ± 11.43^{b}	147.90 ± 11.58^{b}
FCR	4.72 ± 0.41^{b}	4.97 ±0.42^{b}	5.43 ± 0.49^{a}	5.28 ± 0.48^{a}
		Week 4		
FI, g bird^{-1}	1162.12 ± 170.85^{b}	1308.97 ± 164.48	1027.33 ± 165.59^{c}	1115.67 ± 146.92^{b}
BWG, g bird^{-1}	275.53 ± 13.37^{b}	292.91 ± 12.38^{a}	228.07 ± 18.10^{c}	233.23 ± 18.24^{c}
FCR	4.22 ± 0.42^{c}	4.46 ± 0.44^{b}	4.50 ± 0.43^{b}	4.78 ± 0.45^{a}
		Week 5		
FI, g bird^{-1}	1756.02 ± 224.18^{c}	1871.45 ± 221.96^{a}	1469.67 ± 174.86^{d}	1666.67 ± 217.31^{b}
BWG, g bird^{-1}	441.04 ± 27.23^{b}	475.29 ± 33.06^{a}	419.65 ± 28.37^{c}	423.13 ± 23.43^{c}
FCR	3.98 ± 0.40^{a}	3.93 ± 0.42^{b}	3.95 ± 0.38^{ab}	3.94 ± 0.38^{ab}
		Week 6		
FI, g bird^{-1}	1933.10 ± 251.50^{b}	2160.73 ± 204.95^{a}	1841.67 ± 230.98^{c}	1931.00 ± 237.41^{b}
BWG, g bird^{-1}	528.83 ± 35.57^{b}	597.27 ± 26.58^{a}	445.88 ± 36.59^{c}	462.12 ± 27.76^{c}
FCR	3.67 ± 0.43^{b}	3.62 ± 0.45^{b}	4.06 ± 0.44^{a}	4.18 ± 0.43^{a}
		Week 7		
FI, g bird^{-1}	2278.77 ± 326.24^{b}	2399.38 ± 347.27^{a}	2019.50 ± 303.48c	2194.33 ± 245.57c
BWG, g bird^{-1}	578.28 ± 29.13^{b}	665.07 ± 28.92^{a}	495.71 ± 22.34c	564.43 ± 30.77d
FCR	3.94 ± 0.41^{b}	3.61 ± 0.44^{b}	4.07 ± 0.43a	3.89 ± 0.45b
		Week 8		
FI, g bird^{-1}	2673.43 ± 394.73b	2829.88 ± 367.76a	2403.50 ± 301.08c	2509.50 ± 328.53c
BWG, g bird^{-1}	684.53 ± 34.24b	756.32 ± 34.71a	584.77 ± 37.86d	596.40 ± 31.95c
FCR	3.91 ± 0.45c	3.74 ± 0.53d	4.28 ± 0.41a	4.04 ± 0.37b

Note: J0L0 = Control feed without lactic acid bacteria; J0L1= Control feed with lactic acid bacteria; J1L0 = Treatment feed without lactic acid bacteria; J1L1 = Treatment feed with lactic acid bacteria; FI = Feed intake; BWG = Body weight gain; FCR = Feed conversion ratio.

Jack bean meal inclusion was reported by Mahardhika *et al.* (2021). Furthermore, Mahardhika *et al.* (2021) noted that the decrease in BWG could be mitigated by enzyme addition, which helps break down antinutrients and improve nutrient availability.

The feed efficiency ratio (FCR) of IPB D1 chickens in this experiment was found to be significantly different ($p<0.05$) among the treatments. The values decreased from 4.72 - 5.43 in week 3 to 3.61 - 4.01 in week 9. However, the Jack bean meal inclusion treatment (J1L0 and J1L1) caused the FCR value to increase ($p<0.05$) compared to the control feed (J0L0 and J0L1). Conversely, prebiotic LAB supplementation significantly improved ($p<0.05$) FCR values both in the control (J0L1) and the treatment feed (J1L1).

The FCR value can be affected by several factors, including chicken breed and strain (Mohammed & Ameen 2023), feed nutrient content and consumption (Sinurat *et al*. 2022), chicken age (Khwairakpam *et al.* 2018), and housing type and environment (Farhadi & Hosseini 2014). The breed and strain of the chickens play a crucial role as genetic differences can influence feed conversion efficiency. Feed nutrient content and consumption are also critical since a balanced diet ensures optimal growth and feed utilization. Additionally, the age of the chickens affects FCR, as younger birds typically have different nutritional requirements compared to older ones.

Furthermore, the effect of Jack bean meal inclusion in the ration on broiler chicken FCR has been reported with varying results. Some studies found it to be unaffected (Alifianty *et al*. 2023; Sudarman *et al.* 2018), while others reported a significant effect (Mahardhika *et al*. 2021). These discrepancies might be due to differences in study design, Jack bean meal processing methods, or the level of inclusion in the diet. The processing of Jack beans, such as soaking and peeling, can reduce antinutritional factors, potentially leading to more consistent results across different studies. The FCR value achieved in this study with IPB D1 chickens, ranging from 3.61 to 5.43, demonstrated values typical for slow-growing chickens, akin to kampong chickens (KUB breed), which were reported to have FCRs ranging from 3.50 to 4.92 in the study by Sinurat *et al*. (2020).

IPB D1 Chicken Carcass Yield

The experimental results demonstrated varying impacts ($p < 0.05$) on chickens' final body weight, carcass weight, and carcass yield (Table 4). Chickens consuming the control feed with LAB (J0L1) achieved the highest final body weight at 1109 g. In contrast, those given control feed without LAB (J0L0) had a lower final body weight of 976.83 g. The treatment feed without LAB (J1L0) resulted in the lowest final body weight of 895.33 g, while chickens on the treatment feed with LAB (J1L1) weighed slightly more at 943 g, yet less than both control groups.

Regarding carcass cut yields (%), which include back yield, breast yield, and upper thigh yield, the highest ($p<0.05$) results were noted in the control feed treatment with the addition of probiotic LAB (J0L1). No significant differences were detected among the control feed without probiotic LAB (J0L0) and the treatment feed

Table 4 Body weight and carcass yield of IPB D1 chickens

Parameter	J0L0	J0L1	J1L0	J1L1
Final body weight, g	976.83 ± 12.51[b]	1109 ± 13.62[a]	895.33 ± 18.0[d]	943 ± 18.45[c]
Carcass weight, g	643.71 ± 17.27	812.4 ± 19.25	513.13 ± 13.14	541.58 ± 14.84
Carcass yield, %	65.88 ± 5.22[b]	73.22 ± 6.58[a]	57.31 ± 2.35[c]	57.37 ± 2.82[c]
Head and neck yield, %	15.22 ± 2.71	15.40 ± 2.77	14.67 ± 2.07	17.40 ± 1.42
Back yield, %	20.44 ± 2.69[b]	23.45 ± 2.23[a]	20.55 ± 2.63[b]	20.91 ± 0.76[b]
Breast yield, %	25.15 ± 1.42[ab]	27.09 ± 2.53[a]	23.87 ±2 .89[b]	24.02 ± 1.74[b]
Wing yield, %	13.95±1.97[b]	14.76±1.44[b]	15.19±1.11[a]	16.25±2.46[a]
Upper thigh yield, %	17.40±2.09[ab]	18.77±1.36[a]	16.47±0.75[b]	16.36±0.47[a]
Lower thigh yield, %	16.47±2.36	17.22±1.22	17.44±1.64	18.09±1.03
Foot yield, %	7.08±0.85	7.28±0.62	8.04±1.29	7.94±1.08

Note: J0L0 = Control feed without lactic acid bacteria; J0L1= Control feed with lactic acid bacteria; J1L0 = Treatment feed without lactic acid bacteria; J1L1 = Treatment feed with lactic acid bacteria.
[a-c]Mean in the same row without a common letter are different at $p<0.05$ by the Tukey test.

with jack bean meal, both without (J1L0) and with the addition of prebiotic LAB (J1L1).

In terms of wing yield carcass cuts, a higher percentage (p<0.05) was observed in the jack bean meal treatment feed (J1L0 and J1L1) compared to the control feed (J0L0 and J0L1), irrespective of the addition of LAB probiotics. Meanwhile, for other carcass cuts, including head and neck yield, lower thigh yield, and foot yield, no differences were observed among all the treatments.

The varying impacts of different feed treatments, including control and jack bean meal inclusion, as well as the addition of prebiotic LAB on chickens' final body weight, carcass weight, and carcass yield, might be attributed to the antinutritional content present in the treatment feed due to the inclusion of jack bean meal in the ration. These results align with the observed decrease in IPB D1 chicken performance in this experiment. This finding contrasts with the report by Sudarman *et al*. (2018), who found no effect on broiler carcass yield when broiler chickens were fed a ration containing Jack bean meal, and with the report by Tavaniello *et al*. (2022), which showed no difference when broilers were fed a ration containing pea bean compared to control feed.

Contrary to the effects of jack bean meal inclusion, the positive impact of adding prebiotic LAB to the drinking water could be attributed to the probiotics' ability to improve digestive tract health. This result aligns with the research findings, in terms of enhanced performance in IPB D1 chickens due to LAB probiotics, which concurrently improved carcass yields and cuts. Khairati *et al.* (2024) reported no difference between the control feed and treatment feed with probiotics LAB regarding carcass weight and cuts in IPB D1 chicken. In addition, Rehman *et al.* (2020) found no difference between the control treatment and treatments with probiotics and prebiotics on broiler carcass weight and cuts. In contrast, Palupi *et al*. (2023) reported an increase in broiler carcass weight and cuts due to Lactobacillus-fermented feed.

CONCLUSION

While the inclusion of jack bean meal in the ration negatively affected chicken performance and carcass weight, the addition of lactic acid bacteria to the drinking water demonstrated a beneficial effect, improving both chicken performance and carcass weight. This suggests that supplementing poultry diets with probiotics can counteract the adverse effects of antinutritional factors in feed ingredients like jack bean meal.

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