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The Effect of *Indigofera* sp. Leaf Meal Supplementation on the Performance of Super Native Chickens in the Starter Phase

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ABSTRACT

This study evaluated the effects of *Indigofera* sp. leaf meal (ILM) supplementation on the growth performance of Super Native Chickens during the starter phase. A total of 96 day-old chicks were allocated to a completely randomized design with four dietary treatments and six replications. The treatments consisted of a commercial diet without ILM (control) and diets supplemented with 5%, 10%, and 15% ILM. The feeding trial was conducted for 28 days. Parameters observed included feed intake, body weight gain, and feed conversion ratio (FCR). Data were analysed using one-way analysis of variance followed by Duncan's multiple range test. The results indicated that dietary inclusion of ILM up to 15% did not significantly affect feed intake throughout the starter phase ($p > 0.05$). Body weight gain was not significantly different among treatments during weeks 1–3; however, a significant improvement was observed in week 4 ($p < 0.05$), particularly in chickens fed diets containing 5% and 15% ILM. Similarly, FCR was significantly improved during week 4, with the 15% inclusion level showing the most efficient feed utilization compared with the control diet. In conclusion, supplementation of ILM, especially at a 15% inclusion level, can improve body weight gain and feed efficiency of Super Native Chickens during the late starter phase without adversely affecting feed intake. These findings suggest that *Indigofera* sp. leaf meal has potential as a locally available alternative feed ingredient to support sustainable poultry production.

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KEYWORDS: *Indigofera* sp., leaf meal, Super Native Chicken, starter phase, growth performance, feed conversion ratio

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INTRODUCTION

The Indonesian poultry industry represents one of the most important livestock sectors supporting national food security and the provision of affordable animal protein. Poultry production in Indonesia continues to expand in response to population growth and increasing consumer demand, and is projected to reach record production levels in the coming years. Despite this positive trend, the sustainability and profitability of poultry production systems face significant challenges, particularly related to disease pressure, feed availability, and production costs. Endemic poultry diseases such as Newcastle Disease and recurring outbreaks of Avian Influenza remain major constraints that negatively affect flock performance and economic returns (Sumiati et al., 2025). In addition, the heavy dependence on imported feed ingredients, especially corn and soybean meal, makes feed prices highly vulnerable to fluctuations in global markets, thereby increasing production costs and reducing profit margins for farmers.

Feed cost constitutes the largest component of total poultry production expenses, highlighting the urgent need for alternative and locally available feed resources. The utilization of agro-industrial by-products and locally adapted feed ingredients has been widely promoted as a strategic approach to reduce reliance on imported raw materials, stabilize feed costs, and enhance the sustainability of poultry farming systems (Sumiati et al., 2025). Several local feed resources, including sago waste, cassava by-products, rice bran, and palm kernel cake, have been investigated as potential substitutes for conventional energy and protein sources in poultry diets. However, the nutritional limitations of some by-products, particularly their low protein content or high fiber levels, often restrict their inclusion rates in commercial poultry rations.

Among locally available protein-rich feed resources, *Indigofera* sp. has gained considerable attention as a promising leguminous plant for animal feeding. *Indigofera* sp. leaf meal is characterized by a relatively high crude protein content, generally ranging from 22% to nearly 30%, moderate crude fat levels, and lower fibre content compared with many other tropical forages (Has et al., 2021; Termizi et al., 2024). In addition to its favourable macronutrient profile, *Indigofera* sp. contains essential minerals such as nitrogen, phosphorus, potassium, and calcium, as well as various vitamins and bioactive compounds including β-carotene, xanthophylls, flavonoids, and carotenoids (Tanjung et al., 2025). These nutritional and functional properties support its potential use as a natural feed supplement capable of improving poultry performance and product quality, including feed intake, egg weight, and cholesterol reduction (Nurhayu et al., 2021; Tanjung et al., 2025).

Previous studies have demonstrated the beneficial effects of *Indigofera* sp. supplementation in different poultry species, including layers, quails, and native chickens. Reported benefits include maintained feed intake, improved body weight gain, enhanced feed conversion ratio, improved egg quality, and favourable blood serum biochemical profiles (Purwanti et al., 2020; Zakariya et al., 2024). Furthermore, certain phytochemical components present in *Indigofera* sp., such as tannins, saponins, and flavonoids, have been reported to positively influence gut health and nutrient utilization when included at appropriate dietary levels (Choi & Kim, 2020). Nevertheless, the type and concentration of tannins and other secondary metabolites must be carefully considered, as excessive levels may negatively affect palatability and nutrient digestibility.

The starter phase represents a critical period in poultry production, as nutritional management during early life strongly influences subsequent growth performance, health status, and overall productivity (El-Azeem et al., 2024; Ravindran & Abdollahi, 2021). During the first four weeks of age, rapid tissue development, immune system maturation, feather growth, and gastrointestinal tract development occur simultaneously (El-Azeem et al., 2024). Super Native Chickens, a crossbreed developed to achieve faster growth rates than traditional native chickens while maintaining adaptability to local conditions, require nutritionally balanced diets to fully express their genetic potential. Typically, starter diets for poultry contain high protein levels (18– 24%) and specific metabolizable energy ranges to support intensive growth (El-Azeem et al., 2024). However, compared with commercial broilers and layers, information regarding standardized protein requirements and alternative feed ingredient utilization in Super Native Chickens remains limited.

Although the potential of *Indigofera* sp. as a protein-rich feed ingredient has been widely reported in layers, quails, and several native chicken types, information regarding its optimal inclusion level in commercial diets for Super Native Chickens, particularly during the critical starter phase (0–4 weeks), is still scarce. Existing studies have mainly focused on soybean meal substitution or the combined use of *Indigofera* sp. with other phytogenic additives, as well as its effects on carcass traits and nutrient digestibility (Kamaruddin et al., 2021; Nurhayu et al., 2021; Supriadi et al., 2021). Given the distinct growth characteristics and nutritional demands of Super Native Chickens, specific evaluation is required to ensure effective and safe utilization of *Indigofera* sp. leaf meal during early growth stages. Therefore, this study aimed to evaluate the effects of different inclusion levels of *Indigofera* sp. leaf meal on feed intake, body weight gain, and feed conversion ratio of Super Native Chickens during the starter phase. The findings of this study are expected to provide scientific evidence supporting the use of locally available feed resources to improve the sustainability and economic efficiency of poultry production systems in Indonesia.

MATERIALS AND METHODS

Study site and duration

The research was conducted at the official residence of Mr. Kasno, located on Jl. Gunung Salju, Amban, Manokwari Regency, West Papua Province, Indonesia. The experiment lasted approximately two months, including the preparation period and the completion of the study.

Birds management

A total of 96 day-old Super Native Chickens was used in this experiment. Upon arrival, all chicks were individually weighed and then sorted based on body weight to ensure uniform distribution. The chicks were randomly allocated into 24 colony litter cages (50 x 50 x 50 cm), with four birds per cage, resulting in a coefficient of variation of 3.21%.

The birds were assigned to one of four dietary treatments as follows:

P0: Commercial feed + 0% *Indigofera* sp. leaf meal (Control).

P1: Commercial feed + 5% *Indigofera* sp. leaf meal.

P2: Commercial feed + 10% *Indigofera* sp. leaf meal.

P3: Commercial feed + 15% *Indigofera* sp. leaf meal.

The commercial feed used in the study had the following nutrient specifications: crude protein 19.5-22.5%, crude fibre max. 5%, crude fat min. 5%, moisture max. 14%, ash max. 7%, calcium 0.9-1.1%, phosphorus 0.6-0.9%, and total aflatoxin max 40ug/kg.

Experimental diets were weighed at the beginning of the study and subsequently on a weekly basis until the end of the starter phase (28 days). Feed was offered *ad libitum*, and bird conditions were monitored at least twice a day. Feed refusals were collected and weighed weekly. Drinking water was provided *ad libitum* throughout the experiment.

Preparation of *Indigofera* sp. Leaf Meal

Indigofera sp. plants were obtained from the Livestock and Forage Breeding Centre in Macuan Village, Prafi District, Manokwari Regency, West Papua Province, Indonesia. The leaves were separated from stems and branches, sun-dried until brittle, ground into a fine powder using a blender, and stored in airtight containers until use.

The nutrient composition of *Indigofera* sp. leaf meal was not analysed in the present study, as the primary objective was to evaluate growth performance responses to different inclusion levels under a standardized commercial basal diet.

Measured variables

The parameters measured were feed intake (g/bird/day), body weight (g/bird), and feed conversion ratio (FCR). Feed intake was calculated by subtracting the residual feed from the total feed offered and dividing the result by the number of birds and the feeding duration. Body weight was recorded weekly, and body weight gain (g/bird/day) was calculated as the difference between final and initial body weights divided by the number of birds and the experimental period. Feed conversion ratio was calculated as the ratio of total feed intake to total body weight gain.

Statistical Analysis

Data were analysed using a Completely Randomized Design (CRD) with four treatments and six replications. One-way analysis of variance (ANOVA) was performed using SPSS Version 25. Differences were considered statistically significant at $p<0.05$. When significant effects were detected, Duncan's Multiple Range Test was applied for post hoc comparisons.

RESULTS AND DISCUSSION

The mean feed intake, body weight gain and FCR of Super Native Chickens across the experimental period is presented in Table 1.

Table 1. Performance of Super Native Chickens fed diets supplemented with *Indigofera* sp. leaf meal (ILM) during the 28-day starter phase

Treatment	Measurement				
	Week 1	Week 2	Week 3	Week 4	Week 1-4
Feed Intake (g/bird/day)					
P0	10.30	17.28	25.59	33.13	21.57
P1	9.19	18.76	27.36	34.96	22.56
P2	9.18	17.23	25.13	33.42	21.24
P3	10.94	18.65	24.52	32.22	21.58
STDEV	0.873	0.842	1.220	1.138	0.571
P-value	0.220ns	0.551ns	0.134ns	0.307ns	0.209ns
Body Weight Gain (g/bird/day)					
P0	5.90	10.42	14.13	13.43[a]	10.97
P1	5.51	10.13	14.39	15.92[b]	11.49
P2	5.72	9.78	13.26	14.20ab	10.74
P3	5.61	9.72	13.21	16.26[b]	11.20
STDEV	0.168	0.327	0.598	1.360	0.321
P-value	0.509ns	0.302ns	0.267ns	0.031*	0.263ns
FCR					
P0	1.743	1.660	1.813	2.485[b]	1.970
P1	1.705	1.853	1.913	2.205ab	1.967
P2	1.612	1.767	1.898	2.397[b]	1.980
P3	1.965	1.928	1.857	1.990[a]	1.932
STDEV	0.150	0.115	0.045	0.220	0.021
P-value	0.405ns	0.369ns	0.508ns	0.008*	0.834ns

P0 : Control, P1 : *Indigofera* sp. 5%, P2 : *Indigofera* sp. 10%, P3: *Indigofera* sp. 15%, STDEV : Standard Deviation, 152 *= significant ($p<0.05$), ns = non-significant ($p>0.05$)

Feed Intake (g/bird/day)

The results indicate that the inclusion of *Indigofera* sp. leaf meal up to 15% did not 155 significantly affect the feed intake of Super Native Chickens throughout the 4-week starter phase ($p > 0.05$) (Table 1).

Body Weight Gain (g/bird/day)

The results (Table 1) show that *Indigofera* sp. leaf meal supplementation did not significantly affect BWG during Weeks 1-3 or the overall 1-4 week period ($p > 0.05$). However, a significant positive effect was observed in Week 4 ($p < 0.05$). In Week 4, groups P1 (5% *Indigofera* sp.) and P3 (15% *Indigofera* sp.) showed significantly higher BWG compared to the control group (P0). 163 Although P2 (10% *Indigofera* sp.) was not statistically different from the control, its BWG was numerically higher.

Feed Conversion Ratio (FCR)

Similar to BWG, the FCR was not significantly affected by *Indigofera* sp. leaf meal supplementation during Weeks 1-3 or the overall 1-4 week period ($p > 0.05$). However, a 168 significant effect was observed in Week 4 ($p < 0.05$) (Table 1). In Week 4, the P3 group (15% *Indigofera* sp. leaf meal) exhibited the most favourable FCR (1.990), which was significantly better than the control (P0) and P2 (10% *Indigofera* sp.). P1 (5% *Indigofera* sp.) also showed an improved FCR compared to the control, although not statistically significant in this specific comparison.

DISCUSSION

Feed Intake (g/bird/day)

The results on feed intake suggests that the palatability of the feed was maintained despite the varying inclusion levels of *Indigofera* sp. leaf meal. This finding is consistent with recent studies on quail, where *Indigofera* sp. leaf meal inclusion did not significantly impact feed consumption (Has et al., 2021; Zakariya et al., 2024). While some studies suggest that tannins, present in *Indigofera* sp., can impart a bitter taste and potentially reduce feed intake, the levels used in this study (up to 15%) did not appear to negatively affect palatability or overall feed intake. The type and concentration of tannins are crucial; some tannins can even have beneficial effects on gut health (Choi & Kim, 2020). This consistency across studies suggests that *Indigofera* sp. can be incorporated into poultry diets at moderate levels without deterring feed consumption. This is a critical factor for alternative feed ingredients, as maintaining feed intake is essential for achieving desired growth performance.

However, a notable observation was that while feed intake in Week 1 was higher than commonly reported values for Super Native Chickens (approximately 7 g/bird/day), it tended to be lower during Weeks 2, 3, and 4 compared with intake ranges commonly reported in previous studies (approximately 19, 34, and 47 g/bird/day, respectively). This discrepancy might be attributable to environmental factors, such as ambient temperature. Environmental conditions, including temperature, humidity, and stocking density, significantly impact broiler feed intake and overall performance. High temperatures, common in tropical regions like Manokwari, can lead to reduced feed intake due to heat stress. Further research correlating local environmental data with feed intake would provide more definitive insights into this observation.

Body weight gain (g/bird/day)

The relatively limited effect of *Indigofera* sp. leaf meal supplementation on body weight gain during Weeks 1–3 may be explained by the high nutritional adequacy of the commercial basal diet used in this study. The crude protein content of the commercial feed (19.5–22.5%) was sufficient to meet the growth requirements of Super Native Chickens during the early starter phase. Under conditions where protein and energy needs are already adequately fulfilled, additional dietary protein from alternative plant sources may not elicit a proportional increase in growth performance. In such cases, growth responses tend to plateau, particularly during early life when feed intake capacity and digestive efficiency are still developing. This condition likely masked the potential contribution of *Indigofera* sp. leaf meal in the early weeks, whereas a clearer improvement in body weight gain was observed in Week 4, coinciding with increased nutrient demands and enhanced digestive capacity, allowing more effective utilization of plant-derived nutrients and associated bioactive compounds.

The improved BWG, particularly in Week 4, suggests that *Indigofera* sp. leaf meal contributes to growth promotion, likely due to its high protein content, ranging from 22-30.53%, and rich profile of essential minerals like nitrogen, phosphorus, potassium, and calcium (Tanjung et al., 2025; Termizi et al., 2024). This high nutritional value, combined with the presence of phytochemicals, may support better nutrient utilization and overall growth. The late-stage effect (Week 4) might indicate a cumulative impact or a greater requirement for these nutrients as the birds mature and their digestive systems become more developed to efficiently utilize the complex components of *Indigofera* sp.. This aligns with findings by Supriadi et al. (2021), who also reported enhanced BWG in native chicken with *Indigofera* sp. supplementation. However, some studies on quails indicate no significant effect of *Indigofera* sp. on BWG (Ullia et al., 2024; Zakariya et al., 2024), suggesting breed-specific responses or differences in experimental conditions.

Our observed BWG for Super Native Chickens (10.74 – 11.49 g/bird/day for Weeks 1-4, and 13.43 – 16.26 g/bird/day for Week 4) was generally higher than those reported for native chickens (Lisnahan et al., 2022; Muhammad et al., 2023). This

corroborates the assertion that Super Native Chickens inherently exhibit faster growth rates than traditional native chickens. The superior genetic potential of Super Native Chickens, coupled with the nutritional benefits of *Indigofera* sp., likely contributed to these improved growth figures.

Feed conversion ratio

A lower FCR indicates more efficient conversion of feed into body mass, which is a key economic indicator in poultry production. The improvement in FCR, particularly at the 15% inclusion level in Week 4, suggests that *Indigofera* sp. leaf meal enhances the efficiency of nutrient utilization. This finding is consistent with Has et al. (2021), who noted that FCR values in quail tend to improve as the ILM was supplemented. The high protein and amino acid content of *Indigofera* sp., along with its rich mineral profile, likely played a role in this enhanced efficiency, as these nutrients are crucial for tissue accretion and metabolic processes (Tanjung et al., 2025). The presence of certain bioactive compounds in *Indigofera* sp., such as saponins and flavonoids, could also contribute to improved nutrient digestibility and gut health, leading to better FCR (Termizi et al., 2024).

Our results are in line with studies in quail showing improved FCR with *Indigofera* sp. supplementation. For instance, Zakariya et al. (2024) found that *Indigofera* sp. could improve FCR in quails. The positive impact on FCR, without negatively affecting feed intake, underscores the potential of *Indigofera* sp. as an effective feed additive to boost the economic efficiency of Super Native Chicken production. Several factors, including environmental temperature, digestive system efficiency, feed form, and overall management, can influence FCR. The consistency of the results, especially in Week 4, indicates a robust effect of the *Indigofera* sp. supplementation, particularly at higher inclusion levels.

The significant improvement in body weight gain and feed conversion ratio observed during the fourth week may be associated with the maturation of the digestive system and enhanced nutrient utilization capacity of the birds (Rahardja, 2021). As chickens approach the end of the starter phase, the development of digestive enzymes and intestinal morphology allows more efficient digestion of complex plant-based feed ingredients, including those containing moderate fibre and secondary metabolites. This physiological adaptation may explain why the positive effects of Indigofera sp. leaf meal became more pronounced at higher inclusion levels during Week 4.

CONCLUSION

This study concludes that supplementing the diet of Super Native Chickens with *Indigofera* sp. leaf meal significantly enhances body weight gain and improves the feed conversion ratio during the fourth week of the starter phase. While overall feed intake remained unaffected, the 15% inclusion level of *Indigofera* sp. leaf meal demonstrated the most significant improvements in both body weight gain (16.26 g/bird/day) and feed conversion ratio (1.990) during this critical growth period. These findings highlight *Indigofera* sp. leaf meal as a promising and cost-effective alternative feed ingredient for Super Native Chickens, capable of boosting performance and feed efficiency in the starter phase. Further research is recommended to investigate the long-term effects up to the finisher phase, its impact on carcass characteristics and organ development, and the optimal balance of protein content in the base diet to maximize the benefits of *Indigofera* sp. Nevertheless, higher inclusion levels of Indigofera sp. leaf meal should be applied with caution, as excessive dietary fibre and antinutritional factors may limit nutrient digestibility if not properly balanced in the basal diet.

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