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Evaluation of Growth Performance and Economic Efficiency of Hybrid Ducks through Herbal Probiotic Feed Supplementation

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ABSTRAK

Tujuan. Penelitian ini bertujuan untuk mengevaluasi pengaruh suplementasi probiotik herbal dalam pakan terhadap performa produksi dan efisiensi ekonomi pemeliharaan itik pedaging hibrida.
Material dan Metode. Penelitian dilaksanakan di Mitra Karya Farm, Blitar, menggunakan 500 ekor DOD itik pedaging hasil persilangan antara itik peking jantan dan khaki campbell betina. Itik dibagi dalam 5 kelompok ulangan, masing-masing berjumlah 100 ekor, dan dipelihara selama 6 minggu dengan pemberian pakan ad libitum yang disusun sesuai standar NRC (1994). Probiotik herbal ditambahkan sebagai feed additive pada pakan basal. Data yang dikumpulkan meliputi konsumsi pakan, pertambahan bobot badan harian, konversi pakan, serta parameter ekonomi seperti biaya produksi, pendapatan, titik impas (BEP), IOFC, IOFCC, dan rasio R/C.
Hasil. Suplementasi probiotik herbal meningkatkan efisiensi pakan dengan FCR rata-rata 2,00 dan memperbaiki performa pertumbuhan itik pedaging. Secara ekonomi, diperoleh nilai IOFC yang kompetitif, dan rasio R/C mencapai 1,26, menunjukkan usaha tergolong menguntungkan.
Kesimpulan. Penggunaan probiotik herbal dalam pakan berpotensi meningkatkan performa produksi dan keuntungan ekonomi pada usaha budidaya itik pedaging hibrida secara berkelanjutan.

Kata Kunci
itik pedaging; probiotik herbal; performa produksi; analisis ekonomi; *feed additive*.

ABSTRACT

Backgrounds. *This study aimed to evaluate the effects of herbal probiotic supplementation in duck feed on the production performance and economic viability of hybrid meat ducks.*
Methods. *A total of 500 unsexed hybrid meat ducklings (DOD), obtained from a cross between Peking drakes and Khaki Campbell ducks, were randomly assigned into five treatment groups (100 ducks per replicate). The experiment was conducted over a 6-week period using a completely randomized design (CRD). All ducks were fed a basal diet formulated according to NRC (1994) standards, with herbal probiotics added to the feed as treatments. Performance indicators measured included feed intake, body weight gain, and feed conversion ratio (FCR). Economic analysis included production costs, revenue, net income, break-even point (BEP), income over feed cost (IOFC), income over feed cost and chick (IOFCC), and revenue-to-cost (R/C) ratio. Data were analyzed using descriptive quantitative methods.*
Results. *Herbal probiotic supplementation positively influenced duck growth performance, resulting in an average FCR of approximately 2.00. Economic analysis revealed improved profitability, with an average R/C ratio of 1.26 and favorable IOFC values. These findings indicate that herbal probiotics can enhance nutrient efficiency without increasing production costs.*
Conclusions. *Incorporating herbal probiotics into duck feed is a promising strategy to improve both biological performance and economic returns in commercial duck farming. Further research is recommended to confirm long-term benefits and broader applicability.*

Key Words
Hybrid meat ducks; herbal probiotics; production performance; economic analysis; feed additive.

I. INTRODUCTION

Poultry meat and eggs are among the most widely consumed animal-derived foods globally, cutting across cultural, religious, and geographic boundaries. Among poultry species, duck meat offers high nutritional value with a complete profile of essential amino acids and a favorable fatty acid composition, characterized by a high proportion of polyunsaturated fatty acids (PUFAs) and a balanced omega-6 to omega-3 ratio (Ismoyowati and Sumarmono, 2019). According to the Food and Agriculture Organization (FAO, 2022), global duck (*Anas spp.*) population reached 1.15 billion in 2020, with Asia accounting for approximately 89% of this total. Major producers include China, Vietnam, Bangladesh, and Indonesia. In Indonesia, the average duck population over the past five years has been approximately 49.18 million birds, with an average annual duck meat production of 37,878 tons, contributing less than 1% to the national total meat production (Direktorat Jenderal Peternakan dan Kesehatan Hewan Kementerian Pertanian, 2021). The intensification of duck meat production demands efficient and sustainable feed technologies that ensure product quality and safety. Feed represents the largest component of total production costs, ranging from 60–70% (Ismita et al., 2022). To reduce reliance on antibiotics as growth promoters, alternative natural feed additives such as probiotics, prebiotics, and phytobiotics have gained attention. Dong et

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al. (2024) reported that probiotics, prebiotics, and phytoextracts can enhance nutrient absorption and improve meat quality, supporting the use of herbal probiotics as functional feed additives.

The synergistic use of probiotics and herbal-derived phytobiotics has shown potential in improving gut microbiota composition, carcass traits, and meat quality. Herbal probiotic supplementation supports gut microbial balance, enhances nutrient digestion, and strengthens immune function, thereby offering a natural barrier against pathogens (Al-Khalaifah, 2018). Additionally, strategies to reduce fat content in poultry meat are increasingly prioritized to meet consumer demand for healthier and functional foods (Abd El-Hack et al., 2020). Herbal probiotics can be developed using fermented plant extracts from turmeric, ginger, curcuma, galangal, noni fruit, garlic, and other botanicals combined with effective microbes such as Lactobacillus spp., rice washing water, and molasses. The fermentation process enriches the mixture with bioactive metabolites that enhance immunity, growth performance, and feed conversion. (Krysiak et al., 2021). A specific product, Immune Herbal Probiotic, combines herbal ingredients (e.g., betel leaf, turmeric, ginger, garlic) with microbial inoculants and molasses, offering dual roles as probiotic and phytobiotic to replace Antibiotic Growth Promoters (AGPs) (Akintayo & Alagbe, 2020)

The prohibition of AGPs in Indonesia under Regulation No. 14/PERMENTAN/PK.350/5/2017 has accelerated the development of such alternatives. Immune Herbal Probiotic has been promoted as a solution to enhance productivity, disease resistance, and feed utilization efficiency in poultry production systems (MoA Indonesia, 2017). Furthermore, economic analysis of poultry production, particularly under alternative feeding strategies, is essential to assess financial viability. Metrics such as Break-Even Point (BEP), Income Over Feed Cost (IOFC), and Income Over Feed Cost and Chick (IOFCC) provide insights into the profitability and cost-efficiency of duck meat enterprises using herbal probiotics (Hernández et al., 2004). Therefore, this study aims to evaluate the economic performance and production traits of meat ducks fed with herbal probiotic-supplemented diets.

II. MATERIALS AND METHODS

2.1 Study Location and Experimental Design

This study was conducted at Mitra Karya Farm, Blitar, Indonesia. A total of 500 unsexed hybrid meat-type ducklings (DOD) were used as experimental animals. The hybrid ducks were obtained by crossing male Peking ducks and female Khaki Campbell ducks. The coefficient of variation in initial body weight among ducklings was maintained below 10%, ensuring uniformity in the experimental population. The ducks were randomly allocated into five treatment groups, each consisting of 100 birds per replicate, and reared for a period of six weeks (42 days). Each experimental unit was housed in a deep-litter pen equipped with ad libitum access to feed and water.

2.2 Probiotic Herbal Feed Additive

The feed additive used in this study was an Herbal Probiotic formulation, consisting of locally sourced herbs and spices including *Piper betle* (betel leaf), *Curcuma xanthorrhiza* (Java turmeric), *Zingiber officinale* (ginger), *Kaempferia galanga* (aromatic ginger), *Curcuma longa* (turmeric), and *Allium sativum* (garlic), combined with probiotic microorganisms, molasses, and essential minerals. The herbal probiotic was prepared following standard extraction and fermentation protocols and administered as a supplement in the basal diet.

2.3 Feeding and Management

All birds were fed a basal diet formulated to meet the nutrient requirements for growing meat-type ducks as recommended by the National Research Council (NRC, 1994). The diet was provided with ad libitum twice daily, at 07:00 and 15:00 hours. Drinking water was also provided freely throughout the trial. The experimental treatments involved supplementation of the basal diet with different levels of herbal probiotic feed additive.

2.4 Experimental Procedures

The biological trial was conducted using ducks grouped into pens of 100 birds per replicate and each pen randomly assigned to a specific treatment. Prior to the experiment, all rearing facilities including floors, feeders, and drinkers were sanitized thoroughly to ensure hygienic conditions and prevent contamination (Sugiharto et al., 2017). The experimental period lasted for 6 weeks (42 days), during which production performance data were collected, including feed intake (g/bird/day), body weight gain (g/bird/day), and feed conversion ratio (FCR). These performance indicators are critical to evaluating the growth efficiency of meat-type ducks in response to dietary interventions (Yunus et al., 2019). Economic performance was assessed concurrently by calculating several profitability indicators, namely production cost, revenue and net income, break-even point (BEP), income over feed cost (IOFC), income over feed cost and chick (IOFCC), and the revenue-to-cost (R/C) ratio. These economic parameters are widely used in livestock production economics to determine the financial viability and return

on investment of feed supplementation strategies (Mubarokah et al., 2024). Data obtained were subjected to descriptive quantitative analysis to interpret biological and economic outcomes of herbal probiotic supplementation under semi-intensive duck farming systems.

2.5 Statistical Analysis

All data collected were subjected to descriptive quantitative analysis. Economic indicators were computed based on input-output models using Microsoft Excel®. Performance data were summarized using means and standard deviations. Comparative trends among treatments were interpreted descriptively in relation to economic viability and biological response to herbal probiotic supplementation.

III. RESULTS AND DISCUSSION

The present study evaluated the effect of herbal probiotic feed supplementation on the growth performance and economic efficiency of hybrid ducks over five experimental replications. The findings demonstrated that probiotic supplementation had a favorable impact on key production parameters. The evaluation of growth performance and economic parameters of hybrid ducks supplemented with herbal probiotics is presented in **Table 1**.

Table 1. Production Performance and Economic Analysis of Hybrid Broiler Duck.

Parameters	Replication					Average
	U1	U2	U3	U4	U5	
Performance Production						
Population (brids)	113	100	96	97	100	101
Final body weight (kg)	1.93	1.86	1.91	1.67	1.87	2
Feed Intake (kg)	430	410	445	360	450	419
FCR	1.97	2.20	2.43	2.22	2.41	2
IOFC (IDR)	21,156	21,438	19,469	19,298	19,602	20,193
IOFCC (IDR)	13,191	12,438	10,094	10,020	10,602	11,269
Economic Parameters						
Production Costs						
DOD	1,017,000	900,000	864,000	873,000	900,000	910,800
Starter Feed	656,625	656,625	656,625	328,313	328,313	525,300
Finisher Feed	1,968,863	1,849,538	2,058,356	1,849,538	2,386,500	2,022,559
Operational Costs	226,000	200,000	192,000	194,000	200,000	202,400
Total Production Costs (IDR)	3,868,488	3,606,163	3,770,981	3,244,850	3,814,813	3,661,059
Selling Price per kg (IDR)	23,000	25,000	25,000	25,000	25,000	24,600
Total Revenue (IDR)	5,016,070	4,650,000	4,584,000	4,049,750	4,675,000	4,594,964
Net Profit (IDR)	1,147,583	1,043,838	813,019	804,900	860,188	933,905
R/C Ratio	1.30	1.29	1.22	1.25	1.23	1.26
BEP Unit (birds)	87	78	79	78	82	81
BEP Selling Price per kg (IDR)	17,738	19,388	20,566	20,031	20,400	19,625

3.1 Production Performance

The average final body weight of hybrid ducks across treatments was 2.00 kg, with individual replicates ranging from 1.67 kg (U4) to 1.93 kg (U1). Feed intake averaged 419 kg per replicate, with the lowest consumption in U4 (360 kg) and the highest in U5 (450 kg). Correspondingly, the average feed conversion ratio (FCR) was 2.00, suggesting an efficient conversion of feed into body mass in all groups, particularly in U1 (1.97). The variation in FCR could be attributed to differences in feed intake behavior and the digestibility enhancement provided by the herbal probiotic supplementation, which aligns with previous studies showing the efficacy of probiotics in improving feed efficiency in ducks ((Sugiharto et al., 2017; Mubarokah et al., 2024)

3.2 Income Over Feed Cost (IOFC) and IOFCC

The IOFC per bird averaged Rp 20,193, with U2 showing the highest value (Rp 21,438) and U4 the lowest (Rp 19,298). The Income Over Feed Cost Chick (IOFCC) followed a similar trend, averaging Rp 11,269, which reflects the profitability per bird when adjusted for population and cost per unit. These values demonstrate the potential of herbal probiotics to maintain positive economic margins even under variable input costs and duck populations. Herbal-based feed additives not only enhance gut health but also contribute to improved nutrient absorption, which positively affects net income per bird (Al-Khalaifah, 2018).

3.3 Cost Structure and Net Profit

The average total production cost per treatment was Rp 3,661,059, with feed (starter and finisher) contributing the largest proportion of cost (approximately 70–75%), consistent with the typical cost structure in poultry enterprises (Yakubu et al., 2020). Starter feed was more economically used in U4 and U5 (Rp 328,313) compared to other treatments (Rp 656,625). Operational costs were relatively stable across treatments, averaging Rp 202,400. The average total revenue obtained was Rp 4,594,964, with U1 reaching the highest income (Rp 5,016,070) due to higher population and body weight. Net profit across treatments averaged Rp 933,905, with the highest in U1 (Rp 1,147,583). These findings confirm that strategic application of herbal probiotics can support profitability in commercial duck production systems, as supported by findings from Mubarokah et al. (2024).

3.4 R/C Ratio and Break-Even Analysis

The Revenue-to-Cost (R/C) ratio averaged 1.26, indicating that every Rp 1.00 invested yielded Rp 1.26 in return. This is a positive indicator of economic viability, especially in U1 (R/C = 1.30) and U2 (R/C = 1.29). The Break-Even Point (BEP) analysis showed that the average BEP unit was 81 birds, and the BEP price per kg was Rp 19,625, which is substantially lower than the selling price (Rp 24,600), ensuring profit margins are maintained. These results underline the economic advantage of probiotic herbal supplementation as a feed additive. It not only improves biological performance but also contributes to economic efficiency by reducing feed cost per unit of gain, improving growth performance, and increasing net returns (Abd El-Hack et al., 2020).

The integration of herbal probiotics in duck feed has demonstrated both biological and financial advantages. From the production standpoint, improvements in FCR and final body weight support enhanced feed efficiency. Economically, increases in IOFC and R/C ratios, alongside acceptable BEP values, indicate strong commercial potential. These findings advocate for broader adoption of phytogenic feed additives in sustainable poultry systems.

IV. CONCLUSION

Herbal probiotic supplementation in the diet of hybrid meat ducks improved both production performance and economic outcomes. Ducks exhibited efficient growth with an average FCR around 2.00, while economic indicators such as IOFC and R/C ratio (average 1.26) showed profitable returns. The feed additive contributed to better nutrient utilization without increasing feed cost. These results suggest that herbal probiotics are a viable and sustainable strategy to enhance productivity and profitability in duck farming. Further studies are encouraged to explore long-term effects and broader applications.

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