



# Effect of Enoki Mushroom (*Flammulina velutipes*) Flour as Feed Additive on Performance of Broiler Chickens

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**Abstract.** This study aims to evaluate the effect of adding Enoki Mushroom (*Flammulina velutipes*) flour as a feed additive on the performance of broiler chickens. A total of 200 day-old chicks (DOC) of the Lohman strain were divided into four treatments with five replications, each containing ten chicks. The treatments included basal diet without the addition of enoki mushroom flour (T0) and basal diet with enoki mushroom flour added at 0.25% (T1), 0.50% (T2), and 0.75% (T3). The parameters measured included feed intake, body weight, and feed conversion ratio (FCR), which were analyzed using ANOVA. The results showed that feed intake and body weight did not differ significantly among the treatment groups ( $P > 0.05$ ); however, a significant effect ( $P < 0.05$ ) was observed on feed conversion ratio (FCR). The study concluded that the addition of enoki mushroom flour reduced the performance of broiler chickens.

**Keywords:** Broiler Chicken, *Flammulina Velutipes*, Feed Additive, Performance.

## 1 Introduction

Broiler chickens are intensively reared poultry known for their rapid growth and are a primary source of animal protein worldwide. These birds typically reach market weight within 21 to 35 days [1]. As global demand for broiler meat continues to rise, optimizing production efficiency has become increasingly important. Among the key factors influencing productivity, feed quality plays a critical role, accounting for approximately 60–70% of total production costs. Consequently, feed additives have been employed to enhance nutrient utilization, growth performance, and flock health.

Antibiotic Growth Promoters (AGPs) were widely used in poultry production due to their proven effectiveness in improving feed efficiency and growth rates. However, concerns over antibiotic residues in meat and the emergence of antimicrobial resistance have prompted regulatory actions. In Indonesia, the use of AGPs in animal feed was officially banned through Ministry of Agriculture Regulation No. 14/2017, aligning with earlier policy shifts in the European Union since 1997 [2]. As a result, research has shifted toward the development of Natural Growth Promoters (NGPs), such as enzymes, probiotics, prebiotics, and phytogetic compounds, as safe and sustainable alternatives. Among emerging NGPs, enoki mushroom (*Flammulina velutipes*) has gained

attention due to its rich content of  $\beta$ -glucans, which are bioactive polysaccharides known for their immunomodulatory and prebiotic properties [3,4]. Several studies have shown that the dietary inclusion of  $\beta$ -glucan-rich mushroom products can improve broiler performance and reduce the time to market [5].  $\beta$ -glucans support intestinal health by promoting beneficial microbiota and enhancing nutrient absorption, ultimately improving growth performance in poultry. Recent studies have demonstrated that dietary supplementation with mushroom-derived  $\beta$ -glucans can improve immune responses, oxidative balance, and production traits in broilers [6,7]. However, limited data exist regarding the optimal inclusion levels of enoki mushroom flour in broiler diets. Therefore, the present study aims to evaluate the effects of dietary supplementation with enoki mushroom flour at inclusion levels of 0.25%, 0.50%, and 0.75% on broiler chicken performance and health parameters.

## 2 Materials and Methods

### 2.1 Research Materials

This study utilized 200 unsexed Day-Old Chicks (DOC) of the Lohmann strain, obtained from PT Japfa Camfeed Indonesia Tbk. Birds were housed in a closed-house cage system with standard ventilation and lighting. The feed used was formulated on-farm (self-mixed). Enoki mushrooms (*Flammulina velutipes*) were used as a feed additive, with approximately 70 kg of fresh mushrooms processed into mushroom flour. Additional materials included feeders, drinkers, rice husk bedding, and standard poultry maintenance equipment.

### 2.2 Research Methods

**Preparation of Enoki Mushroom Flour.** Fresh enoki mushrooms were trimmed, and stems were removed. The mushrooms were chopped into 3 cm pieces and oven-dried at 60 °C for 12 hours. The dried material was then ground into flour using a laboratory grinder and stored in airtight containers.

Proximate analysis of the mushroom flour showed the following composition: crude protein (CP) 31.2%, crude fiber (CF) 3.3%, crude fat 5.8%, ash 7.61%, and moisture 10.55%. The  $\beta$ -glucan content was determined using enzymatic colorimetric methods, yielding 12.3% (w/w) [16].

**Basal Diet Formulation.** The basal diet was formulated to meet the nutrient requirements of broiler chickens based on NRC (1994) standards. The diet contained approximately:

- Crude protein (CP): 21.5%
- Metabolizable energy (ME): 3,050 kcal/kg
- Crude fiber (CF): 4.2%

The same basal diet was used across all treatments, with the enoki mushroom flour added according to treatment level.

**Experimental Design.** This study employed a Completely Randomised Design (CRD) with four dietary treatments, each treatment consisted of five replications with 10 birds per replicate ( $4 \times 5 \times 10 = 200$  birds). The treatments were as follows:

- T0: Basal diet (control)
- T1: Basal diet + 0.25% enoki mushroom flour
- T2: Basal diet + 0.50% enoki mushroom flour
- T3: Basal diet + 0.75% enoki mushroom flour

Broiler were raised from day 1 to day 35. Feed and water were provided ad libitum. Feed was offered twice daily (07:00 and 16:00). All management practices followed standard commercial broiler production protocols.

**Measured Parameters.** The performance variables measured included:

- Feed intake (g)
- Final body weight (g)
- Feed conversion ratio (FCR)

Feed conversion ratio/FCR was calculated based on [8]:

$$FCR = (\text{Feed intake (g)}) / (\text{Live weight (g)}) \quad (1)$$

$$\text{Body Weight Gain} = \text{Final Body Weight (g)} - \text{Initial Body Weight (g)} \quad (2)$$

### 2.3 Data Analysis

Data were tabulated using Microsoft Excel 2021 and analyzed by one-way Analysis of Variance (ANOVA) using IBM SPSS Statistics version 26.0. Differences among treatment means were evaluated using Duncan's Multiple Range Test (DMRT), with significance set at  $P < 0.05$ .

## 3 Results and Discussion

The effects of dietary supplementation with *Flammulina velutipes* (enoki mushroom) flour on broiler chicken performance are presented in Table 1. Statistical analysis indicated that while feed intake was not significantly affected ( $P = 0.05$ ), both final body weight and feed conversion ratio (FCR) were significantly influenced by treatment.

Feed intake showed a numerical increase in groups T2 and T3, suggesting a possible appetite-stimulating effect of bioactive compounds in enoki mushrooms such as  $\beta$ -glucan. This aligns with findings by [9], who reported increased feed intake when dietary fiber increased, particularly when energy content was lower. However, this did not translate into improved body weight or FCR, suggesting that nutrient bioavailability may have been compromised.

The decline in performance metrics, particularly in body weight and feed efficiency at higher inclusion levels (0.5–0.75%), may be attributed to the high crude fiber and oxalate content of mushroom flour. Oxalic acid, a known antinutrient, can chelate calcium and form insoluble complexes, impairing nutrient absorption and bone develop-

ment [10]. Unfortunately, chemical characterization of the enoki flour (e.g., fiber, oxalate,  $\beta$ -glucan content) was not conducted in this study, limiting direct correlation with performance. Future research should incorporate proximate analysis and bioactive profiling.

**Table 1.** Effect of Enoki Mushroom (*Flammulina velutipes*) Flour as Feed Additive on Performance of Broiler Chickens.

Variables	Treatments			
	T0	T1	T2	T3
Feed Intake (g/bird)	2608.72±40.82	2631.44±20.57	2697.43±55.83	2700.57±53.41
Body Weight (g/bird/period)	1593.88±16.56	1581.09±24.71	1558.14±25.98	1573.57±25.65
Feed Conversion Ratio	1.72 ± 0.03 <sup>a</sup>	1.67 ± 0.04 <sup>a</sup>	1.77 ± 0.04 <sup>b</sup>	1.72 ± 0.05 <sup>a</sup>

\* Different superscripts in the same row indicate significant differences ( $P < 0.05$ ) using Duncan's Multiple Range Test.

These findings are consistent with [11], who reported that dietary inclusion of mushroom stem waste at  $\geq 0.5\%$  in broilers reduced growth and feed efficiency, likely due to structural polysaccharide complexity. Similarly, [12] found that unprocessed fungal additives in poultry feed led to decreased nutrient digestibility. [13] suggested that processing methods such as enzymatic hydrolysis or aqueous extraction can significantly reduce the fiber content and enhance the bioavailability of fungal  $\beta$ -glucans, thereby improving their functional efficacy as feed additives [14].

The highest average body weight was observed in the control group (T0), followed closely by T1. Treatments T2 and T3 exhibited slightly lower weights, possibly due to reduced nutrient absorption or interference from antinutritional compounds. Although T1 showed a marginally better FCR than the control, the difference was not statistically significant. Feed efficiency, reflected in FCR, declined in treatments with higher levels of mushroom flour. Excessive supplementation may lead to inefficient nutrient utilization due to digestive burden or feed wastage, especially if physical feed quality and feeder design are suboptimal [15].

The optimal inclusion level in this study appears to be at or below 0.25%, as T1 did not differ significantly from the control in FCR and showed only a modest decline in body weight. However, higher inclusion levels (0.50–0.75%) were clearly detrimental to performance. This highlights the need for precise dosing and potentially improved processing methods before commercial application.

## 4 Conclusion

The results of this study demonstrate that dietary inclusion of enoki mushroom (*Flammulina velutipes*) flour at levels  $\geq 0.25\%$  resulted in reduced body weight gain and increased feed conversion ratio (FCR) values compared to the control group. These

outcomes suggest a decline in feed efficiency, potentially due to the presence of antinutritional factors in whole mushroom flour. Further research is recommended to evaluate lower inclusion rates or the use of purified  $\beta$ -glucan extracts to optimize growth performance while minimizing negative impacts.

**Disclosure of Interests.** The authors have no competing interests to declare that are relevant to the content of this article.

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