Evaluating the Impact of Four Integrated Technologies Feed Additive on Broiler Performances

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Abstract. The global prohibition of Antibiotic Growth Promoters (AGPs) in broiler production has accelerated the search for sustainable alternatives to maintain poultry performance. One promising approach is the integration of multiple feed technologies, including fractionation, precision biotics, nutrient protection, and granule formulation (AETT). This study investigated the effects of AETT as a feed additive on the performance of broiler chicken. The 200 MB lohman broilers were randomly assigned to four treatment groups: 0% (control), 0.25%, 0.50%, and 0.75% AETT. All groups received a basal diet formulated to meet broiler nutritional requirements. Over a 35-day period, feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), and performance index (PI) were recorded and analysed using one-way ANOVA.The results indicated no statistically significant improvements in FI, BWG, or PI among the AETT-supplemented groups compared to the control ($p > 0.05$). However, minor numerical differences in PI were observed, suggesting potential performance benefits under specific conditions. Overall, this study suggests that four integrated technologies, antibiotic-free solutions warrant further investigation within varied production contexts.

Keywords: Broiler chickens, feed additive, six technologies, performance.

1 Introduction

The prohibition of Antibiotic Growth Promoters (AGPs) in broiler farming has sparked a decisive shift in the poultry industry, primarily due to growing concerns over antibiotic resistance and negative health repercussions for humans [1]. Historically, AGPs were employed to enhance feed efficiency and growth in broilers, but their adverse effects prompted global regulations mandating alternative strategies. Researchers have subsequently investigated diverse natural feed additives, including plant extracts and probiotics, to sustain productivity and improve poultry health [2]. Despite promising outcomes, replacing AGPs with plant-based or microbial additives can be challenging

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due to variable broiler responses under different rearing conditions, and variations in nutrient digestibility often require dietary adjustments [3] [4].

A four integrated technologies approach integrating fractionation, precision biotics, nutrient protection, and granule formulation has emerged as a promising alternative. Fractionation enhances nutrient bioavailability by removing anti-nutritional factors, while precision biotics help maintain a balanced intestinal microbiota, crucial for nutrient absorption and disease resistance [5], [6]. Nutrient protection safeguards essential vitamins and proteins from degradation, improving feed efficiency. Additionally, granule formulation promotes uniform nutrient distribution, aiding in consistent broiler performance [5], [6]. Recent studies (2023–2024) highlight the synergistic effects of combining prebiotics, enzymes, and encapsulation, showing significant improvements in broiler growth, feed conversion, and health [7] [8].

Based on these considerations, this study hypothesizes that integrating fractionation, precision biotics, nutrient protection, and granule formulation into broiler diets will enhance growth performance and feed efficiency compared to single-additive methods. The expected outcome is an improvement in body weight gain (BWG), feed conversion ratio (FCR), and overall performance index (PI), demonstrating the efficacy of multi-technology approaches under controlled conditions.

2 Materials and Methods

2.1 Experimental Design and Treatments

This study employed a Completely Randomized Design (CRD) to evaluate the impact of four integrated technologies (AETT) fractionation, precision biotics, nutrient protection, and granule formulation on broiler performance. Selection of this design aligns with prior research, where CRD or Randomized Block Designs have been effectively used to assess various inclusion levels of feed additives [5], [9]. In determining the precise inclusion rates (0.25%, 0.50%, and 0.75%) of the integrated feed additive, the experimental team adhered to established practices of referencing both preliminary trials and published studies with similar dosage ranges [10]. These levels were chosen to provide a sufficiently broad gradient to detect significant differences in performance indicators without exceeding safe feeding thresholds. The AETT additive consisted of fractionated of rice bran and corn, precision biotics from the rice bran fractination, protection compounds (margarine/butter), and granule-formulated carriers. Fractionation parameters included hydrolysis and filtration, while the coating matrix consisted of polysaccharides and lipids to enhance stability and delivery. The additive was supplied by CV.Mitra Ruminansia Perkasa, Indonesia.

A total of 200 Lohman MB broilers (initial weight 39.53 ± 2.82 g) were randomly assigned to four treatment groups (P0 = 0% AETT, P1 = 0.25% AETT, P2 = 0.50% AETT, and P3 = 0.75% AETT), each with five replicates of 10 birds. Standard husbandry conditions, including ambient temperature, relative humidity, and ventilation, were maintained in accordance with recommended guidelines for broiler growth. Temperature and humidity were recorded throughout the trial, but no statistical analysis was performed on these environmental variables. Thermal Load Index (THI) was calculated to contextualize the lack of additive response, using the formula THI = (0.8 × T) + (RH × (T - 14.4)) + 46.4, where T = temperature (°C) and RH = relative humidity (%). Each replicate unit measured 1.2 × 1.2 m and was equipped with manual feeders and drinkers to ensure uniform access to feed and water. Biosecurity protocols such as disinfection of equipment and controlled human traffic were strictly enforced [3].

All birds received a basal commercial feed (produced by PT. New Hope Jawa Timur) formulated to meet or exceed NRC (National Research Council) requirements. The AETT additive was mixed thoroughly in the basal feed according to each treatment's designated inclusion level. Where relevant, mineral and vitamin premixes were adjusted so that each treatment received equivalent baseline nutritional content.

2.2 Data Collection and Statistical Analysis

Feed intake was measured daily by subtracting feed refusals from the total feed offered [23]. Body weight was recorded weekly, and body weight gain (BWG) was calculated cumulatively for each experimental unit. Feed conversion ratio (FCR) was then derived by dividing total feed intake by total BWG [24]. Mortality was monitored continuously, and necropsies were performed to identify potential causes of death. The Performance Index (IP) was calculated by integrating growth rate, FCR, and livability [14]. The Performance Index (IP) was calculated as follows:

$$\mathrm{IP} = \frac{(\text{Average daily gain x liavibility})}{\text{FCR x day of harvesting}}\ x\ 100\% \tag{1}$$

Statistical analysis was conducted using one-way ANOVA in SPSS version 25.0, following verification of normality and homogeneity of variance. Duncan's Multiple Range Test was applied to differentiate means (p<0.05).

3 Results and Discussion

This section presents the effects of administering the four integrated technologies (AETT) at varying inclusion levels (0%, 0.25%, 0.50%, and 0.75%) on the overall performance of broiler chickens. The indicators observed include feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), performance index (IP). Environmental parameters, such as ambient temperature and relative humidity, are also reviewed to evaluate potential influences on bird performance. Unless otherwise stated, differences discussed refer to statistical significance at $p < 0.05$. The present study investigated the effect of fractionation, precision biotics, nutrient protection, and granule formulation (AETT) on broiler performance, with particular emphasis on feed intake (FI), body weight gain (BWG), feed conversion ratio (FCR), performance index (IP). Overall, the results revealed no statistically significant differences ($p > 0,05$) among treatments, although numerical trends offered insights into the potential for integrative feed technologies. This section discusses these findings in light of current literature, highlighting possible mechanisms, constraints, and implications for broiler production. Effect of AETT on broiler performances can be seen in the Table 1.

Table 1. Effect of AETT on broiler performances.

Treatment	P0	P1	P2	P3
Feed Intake (g/bird)	3496.3±22.6	3479.67±4.24	3517.87±77.85	3488.41±4.21
body weight (g/bird)	2350.33±87.99	2341.70±25.89	2362.41±54.29	2336.44±17.05
FCR	1.488±0.05	1.486±0.02	1.489±0.06	1.493±0.01
Index Performance	436.36±25.24	444.69±21.11	448.69±39.71	460.28±6.45

A striking feature in our results was the lack of significant improvement in FI and BWG among AETT-supplemented groups compared to controls. This outcome can be interpreted through main factors such as adequate nutrient density and trial duration potentially masking long-term gut health benefits. Firstly, the adequate nutrient profile of the basal diet may have limited the extent to which additional feed technologies could enhance performance. Some natural additives and probiotic strains are known to reduce FI without compromising growth [11], However, our data reflect a different scenario where FI remained stable, consistent with studies indicating that certain non-antibiotic growth promoters do not markedly influence appetite [12], [13]. The nutrient sufficiency likely minimized the additive's potential to elicit improvements, as broilers receiving nutritionally optimal diets are less responsive to additional feed interventions. Moreover, the study's-controlled environment minimized heat stress, a factor that can modulate FI and [14]. Consequently, any advantage conferred by fractionation or nutrient protection may have been partially masked by already favorable rearing conditions. Previous studies have demonstrated that feed additives like probiotics and nutrient protectors are more effective under challenging conditions, such as high ambient temperatures or heat stress [15]. Lactobacillus and other probiotic strains can outcompete pathogenic microbes, while prebiotics such as inulin encourage the proliferation of beneficial gut bacteria [16]. However, under low-stress conditions with already robust gut health, the marginal improvements from precision biotics may not be immediately apparent. In our study, the uniformly low mortality rate indicated minimal disease pressure, potentially limiting the observable impacts of gut-modulating additives [17]. Additionally, postbiotic compounds derived from microbial fermentation can strengthen the intestinal barrier [18], although no significant gains in performance indices were noted, suggesting that the baseline health status may have already been optimal [19].

Another relevant factor involves the fiber content of the diet, which can strongly influence digestion and nutrient assimilation [20]. Excessive fiber—particularly insoluble types—may impair nutrient uptake and decrease bird performance. Previous research indicates that diets exceeding 10% crude fiber can substantially reduce BWG [21]. In our study, fractionation technology was intended to remove anti-nutritional factors, potentially mitigating the negative effects of fiber. However, since the baseline ration was already within recommended fiber thresholds, further decreases in fiber might not have conferred a substantial performance edge. This outcome aligns with findings that moderate fiber levels do not necessarily harm performance when combined with balanced nutrients and beneficial microbes [16]. In line with integrative approaches, fractionation can improve nutrient quality, precision biotics can stabilize gut health, nutrient protection can preserve essential amino acids and vitamins, and granule formulation can maintain feed homogeneity [22]. Thus, under suboptimal conditions, these technologies may collectively exert a more pronounced effect. The absence of such suboptimal stressors here might explain why improvements remained negligible.

4 Conclusion

This study assessed the application of four integrated feed technologies fractionation, precision biotics, nutrient protection, and granule formulation (AETT) for enhancing broiler performance. Although no statistically significant improvements emerged in feed intake, body weight gain, feed conversion ratio, performance index, several numerical trends suggest that AETT may yield marginal benefits when baseline conditions are less optimal. Specifically, fractionation could reduce anti-nutritional factors, while precision biotics might enhance gut health, nutrient protection stabilizes key vitamins and amino acids, and granule formulation maintain feed homogeneity. From a practical standpoint, these technologies appear capable of maintaining broiler health and performance without antibiotic growth promoters, thus contributing to sustainable production. The study's findings underscore the importance of tailoring multi-technology approaches to specific rearing challenges, including environmental stressors and dietary imbalances. By applying AETT under more demanding conditions, such as heat stress or nutrient-limiting diets, future investigations may more fully elucidate its utility. The present research advances understanding of how integrative feed additives function in a controlled environment and highlights the necessity of further cost–benefit analyses and commercial-scale trials for definitive conclusions.

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

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