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Economic evaluation of phytobiotic supplementation in broiler chicken

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Abstract

The present study evaluated the economic efficiency of dietary supplementation with a phytobiotic mixture containing *Phyllanthus niruri* and *Curcuma longa* in broiler chickens. A total of 180 day-old broiler chicks were randomly allotted to five dietary treatments comprising a control, an antibiotic-supplemented group, and three phytobiotic-supplemented groups at 0.5%, 1.0%, and 1.5% inclusion levels for a period of six weeks. Economic analysis was performed by considering variable costs such as chick cost, feed cost, and additive cost, while income was calculated based on final live body weight. The results revealed that broilers fed 0.5% phytobiotic mixture recorded the highest net profit, profit per bird, and benefit-cost ratio, along with the lowest cost per kilogram of live weight. Higher inclusion levels increased production cost without proportional economic benefits. The study concludes that supplementation of a 0.5% phytobiotic mixture is the most economically viable option for sustainable and antibiotic-free broiler production.

Keywords: Phytobiotics, *Phyllanthus niruri*, *Curcuma longa*, broiler chickens, economic efficiency, profitability

1. Introduction

Economic efficiency is a major determinant of profitability in broiler production, as feed cost constitutes the largest share of total production expenses (Mehta and Nambiar, 2008) [1]. The extensive use of antibiotic growth promoters to enhance performance has been restricted due to concerns related to antimicrobial resistance and food safety, prompting the search for natural and economically viable alternatives (Raza *et al.*, 2019; Lillehoj *et al.*, 2018) [2, 3]. Phytobiotic feed additives derived from medicinal plants have gained importance owing to their growth-promoting, antimicrobial, antioxidant, and digestive-enhancing properties, which can positively influence production efficiency and economic returns (Wickramasuriya *et al.*, 2024) [4].

Among phytobiotics, *Curcuma longa* and *Phyllanthus niruri* have been reported to improve feed utilization, growth performance, and health status in broiler chickens (Jagadeeswaran *et al.*, 2011; Ayalew *et al.*, 2022; Pasaribu *et al.*, 2023) [5, 6, 7]. Improved feed conversion and reduced health-related losses associated with these herbs can contribute to better income over feed cost and overall profitability. However, studies evaluating the economic impact of their combined supplementation at different inclusion levels are limited.

Therefore, the present study was undertaken to assess the economic efficiency of dietary supplementation with a phytobiotic mixture containing *Phyllanthus niruri* and *Curcuma longa* in broiler chickens, with emphasis on production cost, feed efficiency, and profitability.

2. Materials and Methods

The economic evaluation of broiler production was carried out to assess the cost-effectiveness of dietary supplementation with a phytobiotic mixture containing *Phyllanthus niruri* and *Curcuma longa*. The analysis was performed following standard poultry economic assessment procedures to allow reproducibility of results.

2.1. Cost components

The variable costs considered in the present study included:

- Cost of day-old broiler chicks,
- Cost of feed consumed during the experimental period,
- Cost of feed additives, including the phytobiotic mixture and antibiotic growth promoter.

Feed cost was calculated based on the actual quantity of feed consumed per bird in each treatment group and prevailing market prices during the study period. The cost of phytobiotic supplementation was computed according to the inclusion levels used in each treatment.

2.3. Income calculation

Income was calculated based on the live body weight of broilers at the end of the experimental period and the prevailing market price per kilogram of live broiler weight. Economic returns were expressed as:

- Total production cost per bird,
- Cost per kilogram of live weight gain,

- Gross income per bird,
- Net profit per bird,
- Income over feed cost (IOFC).

2.4. Excluded costs: Fixed costs such as housing, equipment, depreciation, labor, electricity, and interest on capital were excluded from the economic analysis, as these facilities were provided by the institute and remained constant across all treatment groups. Similarly, recurring costs such as brooding bulbs and miscellaneous management expenses were not included, since they were identical for all treatments and did not influence comparative economic outcomes.

3. Results

The techno-economic parameters adopted for the economic evaluation of broiler production are presented in Tables 1, 2 and 3. Parameters such as chick cost, feed cost, additive cost, stocking density, and marketing age were maintained uniformly across all treatment groups to ensure a valid economic comparison.

Table 1: Techno-economic parameters

S. No.	Particular	Value
1	Day-old chick cost (₹/chick)	40
2	Number of chicks per treatment	36
3	Floor space per bird (sq.ft)	1
4	Days on paper/cardboard	10
5	Average feed cost (₹/ kg)	42
6	Feed additive cost (₹/ kg)	Turmeric ₹200/ kg <i>Phyllanthus niruri</i> ₹450/ kg, Antibiotic ₹700/ kg
7	Age at marketing	42 days
8	Total feed purchased	750 kgs

Table 2: The economic performance of broilers under different dietary treatments is summarized below

S. No.	Particular	C (Control)	R (Antibiotic)	T ₁ (0.5%)	T ₂ (1.0%)	T ₃ (1.5%)
Expenditure						
1	Feed consumed (kg)	118.76	123.12	123.73	123.36	116.74
2	Feed cost (₹ = kg × 42)	4,987.92	5,171.04	5,196.66	5,181.12	4,903.08
3	Chick cost (36 × ₹40)	1,440.00	1,440.00	1,440.00	1,440.00	1,440.00
4	Additive used (kg)	0.000	0.030	0.618	1.250	1.751
5	Additive cost (₹)	0.00	21.5	201.64	408.1	569.1
6	Total expenditure (₹)	6,427.92	6,632.54	6,838.3	7,029.22	6,912.18
Income and profit						
	Particular	C (Control)	R (Antibiotic)	T₁ (0.5%)	T₂ (1.0%)	T₃ (1.5%)
	Final birds (alive)	36	35	36	36	36
	Total live weight	69.72	67.60	74.62	69.61	71.29
	Income from live birds ₹105/Kg live weight	7320.6	7089	7835.1	7309.05	7485.45
	Total income (₹)	7320.6	7089	7835.1	7309.05	7485.45
	Total cost (₹)	6,427.92	6,632.54	6,838.3	7,029.22	6,912.18
	Net profit (₹)	892.68	465.46	996.8	279.83	573.27
	Profit per bird (₹)	24.7	13.29	27.68	7.77	15.92
	Benefit-Cost Ratio (BCR)	1.13	1.07	1.14	1.03	1.08

Table 3: Cost of production and savings (per kg)

Particular	C	R	T ₁	T ₂	T ₃
Total cost (₹)	6,427.92	6,632.54	6,838.3	7,029.22	6,912.18
Total live weight (kg)	69.72	67.60	74.62	69.61	71.29
Cost/kg live weight (₹)	92.19	98.11	91.64	100.98	96.95
Saving vs Antibiotic (live/kg ₹)	+5.91	-	+6.47	-2.86	+1.15

The total cost of production was lowest in the control group (₹6,427.92) and highest in the T₂ group (₹7,029.22). Although supplementation of phytobiotic mixtures improved growth performance and carcass traits, higher inclusion levels (1.0% and 1.5%) resulted in increased additive costs, thereby elevating total expenditure. Similar trends have been reported

earlier, indicating that excessive inclusion of herbal additives may not always yield proportional economic benefits.

The highest net profit (₹996.80) and profit per bird (₹27.68) were recorded in the T₁ group (0.5% phytobiotic mixture), followed by the control group (₹892.68). The benefit-cost ratio (BCR) was also highest in T₁ (1.14), indicating superior

economic efficiency of this inclusion level. The antibiotic-supplemented group and higher phytobiotic inclusion groups (T₂ and T₃) showed comparatively lower profitability due to higher input costs and reduced economic efficiency.

The cost of production per kilogram live weight was lowest in the T₁ group (₹91.64/ kg), followed by the control group (₹92.19/ kg), whereas the highest cost was observed in T₂ (₹100.98/ kg). When compared with the antibiotic group, savings per kilogram live weight were ₹6.47, ₹5.91, and ₹1.15 in the T₁, control, and T₃ groups, respectively, while T₂ showed a negative saving (–₹2.86/ kg). These results clearly demonstrate that moderate inclusion of phytobiotic mixtures improves cost efficiency.

The improved economic performance observed in the T₁ group may be attributed to better feed utilization, improved gut health, and enhanced growth performance resulting from the synergistic effects of *Phyllanthus niruri* and *Curcuma longa*. These herbs possess antioxidant, antimicrobial, and hepatoprotective properties, which contribute to improved nutrient absorption and reduced health-related losses.

The present findings are in agreement with earlier studies. Kafi *et al.* (2017)^[8] reported higher net profit in broilers supplemented with turmeric, while Enyenihi *et al.* (2023)^[9] observed improved economic efficiency at optimal turmeric inclusion levels. Similarly, Sabdoningrum *et al.* (2023)^[10] reported that *Phyllanthus niruri* supplementation enhanced income over feed cost, with diminishing returns at higher inclusion levels.

Overall, the results indicate that supplementation of a 0.5% phytobiotic mixture of *Phyllanthus niruri* and *Curcuma longa* provides the most economically viable option, maximizing profitability and supporting sustainable, antibiotic-free broiler production.

4. Conclusion

Based on the economic evaluation, dietary supplementation with a phytobiotic mixture containing *Phyllanthus niruri* and *Curcuma longa* significantly influenced the profitability of broiler production. Among the different inclusion levels tested, supplementation at 0.5% resulted in the highest net profit, benefit-cost ratio, and lowest cost per kilogram of live weight. Although higher inclusion levels improved growth performance, the increased cost of additives reduced overall economic efficiency. The findings demonstrate that moderate inclusion of phytobiotic mixtures can effectively replace antibiotic growth promoters while enhancing profitability. Therefore, supplementation of a 0.5% phytobiotic mixture is recommended as a cost-effective and sustainable strategy for antibiotic-free broiler production.

5. Conflict of Interest

Not available

6. Financial Support

Not available

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