**Effect of Different Levels of Amla (Emblica Officinalis) Fruit Powder Supplementation on the Production Performance of Broilers**

**ABSTRACT**

Natural fruits have the potential to substitute growth-promoting antioxidant properties, reducing pathogens, enhancing food utilization, gut health, and production performance. The current study aims to evaluate the dietary influence of Amla (*Emblica officinalis*) fruit powder in various doses on broiler chicken production performance. A total of 120-day-old Cobb 500 broiler chicks were randomly selected into four treatment groups, each consisting of three replications of 10 birds: T0 (control diet), T1 (0.5% amla powder in feed), T2 (1% amla powder in feed) and T3 (1.5% amla powder in feed). Body weight gains, feed conversion ratio (FCR), mortality and carcass traits were recorded. Feed intake (g/bird) was almost similar (P>0.05) among the dietary groups. Body weight gain (g) and FCR were significantly (P<0.05) different among the dietary groups. The highest body weight gain (g) was (P<0.05) in T3 (1555.15g), followed by T2 (1503.04 g), T1 (1479.38g) and T0 (1318.68g), respectively. The lowest FCR was found in T3 (1.37) and the highest FCR in T0 (1.54), with the intermediate in T1 (1.41) and T2 (1.40), respectively. It was found that there was a significant (P<0.05) difference among the dietary groups in case of carcass weight (g). live weight (g), thigh weight (g), and breast (g), but there was almost no similarity (P>0.05) among the dietary groups for heart weight (g), spleen weight(g), gizzard weight(g), head (g), and intestine weight (g). Carcass weight in T3 (905.15g) and live weight in in T3 (1496.11g) were significantly (P < 0.05) different compared to control T0 (668.55g) and T0 (1160.52 g), respectively. Microbial loads (E. coli and Salmonella sp.) of faecal samples were significantly (P <0.05). No mortality was found among the dietary groups during the experimental period. The T3 group showed the best performances among all the groups and was recommended.

***Keyword:***  Amla (Emblica officinalis), Broiler, Microbial load, performance,

1. **INTRODUCTION**

Bangladesh is regarded as one of the most suitable places in the world for chicken farming. The poultry business contributes significantly to economic growth while also creating a large number of job possibilities. Poultry eggs and meat have recently emerged as important and popular foods for 68% of the non-vegetarian population [1,20]. Antibiotic use has a negative impact on animal health and production, including residues in tissues, withdrawal periods, and the development of resistance in microorganisms [11,15]. Currently, there are numerous natural growth promoters on the market, such as herbs, probiotics, prebiotics, and synbiotics. Amla (*Emblica officinalis*) fruit powder is one of the herbs with the potential to increase grill output. Emblica officinalis (Amla) is an excellent source of ascorbic acid, minerals, amino acids, tannins, and phenolic compounds [18,23]. Amla fruit powder also has adaptogenic, antistress, and immunogenic qualities, which improve broiler performance [22]. It also has antibacterial [21], antifungal [7], and anti-inflammatory effects [3,5,6,9,9,19]. According to Zuyie *et al.* [23], herbal feed additives have garnered scientists' interest in the past ten years as a valuable tool for boosting productivity without causing any negative impacts like residues in meat products. As a result, the current study was designed to assess the dietary addition of *E. officinalis* (Amla) fruit powder on broiler chicken development performance.

**2. MATERIAL AND METHOD**

**2.1 Experimental site**

The experiment was carried out at Hajee Mohammad Danesh Science and Technology University's Poultry Farm in Dinajpur from 13 December 2019 to 11 January, 2020.

**2.2 Experimental birds**

For the experiment, 120-day-old broiler chicks (Cobb500) were collected from the Kazi Farm hatchery via local traders. The chicks were randomly assigned to four nutritional treatment groups (T0, T1, T2, T3), each of consisted of three replications with 10 birds. The following are the treatments: T0 = control, T1 = control + 0.5% amla powder with feed, T2 = control + 1% amla powder with feed and T3 = control + 1.5% amla powder with feed. The Amla was added and mixed with other feed ingredients thoroughly and carefully. After a week of introspection, the treatment plan was implemented over a period of 7 to 28 days. Two birds were slaughtered on the final day of each replication of the experiment. Amla was gathered and prepared from the Hajee Mohammad Danesh Science and Technology University (HSTU) botanical garden in Dinajpur-5200, Bangladesh. Fresh fruits were gathered, washed, and allowed to dry in the sun. Fruits that had been sun-dried then were ground into fine flour.

**2.3 Managemental practices**

Commercial feed was employed in the experiment. The feed used in the experiment was purchased from a Dinajpur feed store. Different feeds range from 16 to 28 days for different ages. Broiler feed was provided three times: in the morning, at noon and in the evening. Essentials like lighting, sanitization, litter, water, and intensive and coop housing were supplied. As planned, the chicks received vaccinations against Infectious Bursal Disease (IBD)(12d) and Ranikhet Disease (RD) (4 and 21d). Appropriate biosecurity measures were implemented during the study.

 **Table.1 composition of experimental diets**

|  |  |
| --- | --- |
| Nutrients | Amount (kg/50kg feed) |
| Starter (1-14 days) | Grower (15-28days) |
| Crude protein (%) | 22 | 21 |
| Crude fiber (%) | 3 | 3 |
| Crude fat (%) | 5 | 5-6 |
| Lysine (%) | 1.30 | 1.25 |
| Methionine (%) | 0.52 | 0.50 |
| Calcium (%) | 1 | 0.90 |
| Phosphorus (%) | 0.50 | 0.48 |
| Moisture (%) | 11 | 11 |
| Metabolizable Energy, ME (k Cal/kg) | 3000 | 350 |

 **Ingredient Amount (%)**

|  |  |
| --- | --- |
| Maize  | 60.70  |
| Soybean meal  | 32.24  |
| Soyabean oil  |  3.0  |
| Dicalcium phosphate  | 2.20  |
| Ground limestone  | 0.61  |
| Choline chloride  | 0.10  |
| DL methionine  | 0.20  |
| L-lysine  | 0.15  |
| Salt  | 0.30  |
| Vitamin –mineral premix\*  | 0.50  |
| \* Vitamin-mineral premix contains in the following per kg: vitamin A, 2400000 IU; vitamin D, 1000000 IU; vitamin E, 16000 IU; vitamin K, 800 mg; vitamin B1, 600 mg; vitamin B2 , 1600 mg; vitamin B6 , 1000 mg; vitamin B12, 6 mg; niacin, 8000 mg; folic acid, 400 mg; pantothenic acid, 3000 mg; biotin 40 mg; antioxidant, 3000 mg; cobalt, 80 mg; copper, 2000 mg; iodine, 400; iron, 1200 mg; manganese, 18000 mg; selenium, 60 mg, and zinc, 14000 mg |  |

**2.4 Calculation**

1. Total gain in weight = final weight –initial weight.

2. Total feed consumption = total feed offered – total left-over

3. Feed conversion ratio = total feed consumed / total gain in weight.

 4. Mortality rate (%) = no. of dead chickens **/** total no. of birds as a group**×** 100
**2.5 Statistical analysis**

The generated data were entered into SPSS version 25 software, which then used one-way ANOVA to analyze them in compliance with the Complete Randomized Design (CRD) principles. Every value was reported as mean ± SEM, and significance was assessed (P < 0.05).

**3.RESULTS AND DISCUSSIONS**

# 3.1 Body Weight

The effect of amla on the highest body weight gain is shown in Table 2. The present study revealed that there was no significant (P>0.05) variation of initial body weight (g/broiler) among the dietary groups, but final body weight (g/broiler) and body weight gain were significantly (P<0.05) different among the dietary groups. The initial body weight (g/broiler) in the T0, T1, T2 and T3 groups was 40.15±0.26, 38.91±0.24, and 39.63±0.39. At 7 days of age, the body weight was almost similar in different dietary groups. Significant differences (p<0.05) were found at 15 days, 21 days and 28 days of age in body weight gain. The highest body weight was found in T3 (1555.15 g), followed by T2 (1503.04g), T1 (1479.38g) and T0 (1318.68g), respectively. However, there was a trend of increasing live weight with the increase of age (P<0.05). There was a tremendous (P<0.05) increase of live weight for increasing amla levels at 15, 21, and 28 days of age in broilers. The result in this study revealed that supplementation of broilers with 0.5%, 1% and 1.5% amla gave rise to (P<0.05) improvement in live weight compared to 0% amla for broilers. There was a tendency of increasing live weight broilers with increasing amla content up to the 1% level [9]. Research results indicate that dietary addition of E. officinalis (Amla) fruit powder at the rate of 0.4% and 0.8% had a higher growth rate [16]*.* The results we obtained were comparable to those of other studies, including Gouri *et al*. [6], Mandal *et al.* [14], Pradeep [18], Zuyie *et al*. [23], Gour *et al*. [5] and Sandeep [19].

**Table.2: Body weight gain and mortality in different groups at different ages of birds**

|  |  |  |
| --- | --- | --- |
| **Age in days /parameter** | **Dietary groups (%)** | **Level of significance** |
| **T0** | **T1** | **T2** | **T3** |
| Initial body weight | 39.53±0.32 | 40.15±0.26 | 38.91±0.24a | 39.63±0.39 | NS |
| 7th | 184.34±0.61 | 183.37±0.24 | 184.11±0.57 | 184.42±0.62 | NS |
| 14th | 266.90±0.82a | 325.28±0.36b | 327.19±0.58b | 341.36±0.64c | \* |
| 21th | 382.08±0.62a | 439.59±0.59b | 445.65±0.58c | 468.09±0.58d | \* |
| 28th | 485.36±0.55a | 531.14±0.58b | 546.09±0.56c | 561.28±0.64d | \* |
| Total body weight (1st-28th) | 1318.68±2.60a | 1479.38±1.77b | 1503.04±2.29c | 1555.15±2.48d | \* |
| Mortality (%) | 00.00 | 00.00 | 00.00 | 00.00 | NS |

T0= Control, T1= Control + 0.5% amla, T2= Control + 1.0% amla and T3= Control + 1.5% amla powder. abc means having different superscript in the same row differed significantly (P<0.05) \*= 5% level of significance, NS= Non- significant.

# 3.2 Feed intake

The difference in feed intake was marked for broilers fed on (P<0.05) at 15 and 21 days of age (Table.3). However, there were slight variations in feed intake at 7 and 28 days of age on different dietary levels. Feed intake at 15 and 21 days of age differed on different diets. Feed intake appeared (P > 0.05) significant at 15 and 21 days of age. Inclusion of amla resulted in a p<0.05 increase in feed consumption at 15 and 21 days of age. It was found that at 0.5%, 1.0% and 1.5%, the amla powder treatment group consumed the highest amount, whereas the lowest was in the 0% treatment group. Significantly, higher feed consumption was recorded by higher consumption of amla [12]. Our results were in line with those of other researchers: Dalal *et al*. [3], Mandal *et al.* [14], Pradeep [18], Zuyie *et al*. [23], Gour *et al.* [5], and Sandeep [19].

**Table.3: Feed intakes (g) in different groups at different ages of birds**

|  |  |  |
| --- | --- | --- |
| **Age in days /parameter** | **Dietary groups (%)** | **Level of significance** |
| **T0** | **T1** | **T2** | **T3** |
| 7th | 202.07±0.54 | 201.33±0.56 | 202.36±0.6 | 201.29±0.63 | NS |
| 14th | 371.64±0.42a | 408.04±0.57b | 418.56±0.54c | 418.36±0.35c | \* |
| 21th | 621.62±0.46a | 637.55±0.44b | 640.3±0.4c | 645.46±0.73d | \* |
| 28th | 838.26±0.61a | 845.27±0.5b | 850.09±0.56c | 860.76±0.37d | \* |
| Total Feed Intake (1st-28th) | 2033.59±2.03a | 2092.19±2.07b | 2111.31±2.10c | 2125.87±2.08d | \* |

T0= Control, T1= Control + 0.5% amla, T2= Control + 1.0% amla and T3= Control + 1.5% amla powder. abc means having different superscript in the same row differed significantly (P<0.05) \*= 5% level of significance, NS= Non significant.

**3. Feed Conversion ratio**

The weekly feed conversion ratio (FCR) of broilers in different treatment groups varied (P < 0.05) at 15, 21, and 28 days of age. At 7 days of age, amla levels showed no changes, which might be attributable to the change caused by the rise in amla feed conversion. The lowest FCR was obtained at the 1.5% amla level. It was significantly better (P< 0.05) than 0.00%, 0.5%, and 1.0% amla levels at 15, 21, and 28 days of age (Table 4). Jeevangi et al. [5] found that a meal containing 0.2% Emblica fruit powder resulted in a higher feed conversion ratio (kg feed per kg weight increase) during the 0-3 wk, 3-6 wk, and 0-6 wk phases (1.93, 1.78, 2.01 vs 2.07) than other treatments, including the control. Our findings were consistent with those of previous investigations by Gamina *et al*. [1], Mandal *et al.* [14], Pradeep [18], Zuyie *et al*. [23], Gour *et al*. [5],5], and Sandeep [19].

**Table 4: Feed conversion ratio (wt gain/feed intake) of different birds of different groups**

|  |  |  |
| --- | --- | --- |
| **Age in days /parameter** | **Dietary groups (%)** | **Level of significance** |
| **T0** | **T1** | **T2** | **T3** |
| 7th | 1.09±0.00 | 1.09±0.00 | 1.09±0.01 | 1.09±0.01 | NS |
| 14th | 1.39±0.00d | 1.25±0.00b | 1.28±0.00c | 1.22±0.00a | \* |
| 21th | 1.62±0.00d | 1.45±0.00c | 1.43±0.00b | 1.38±0.00a | \* |
| 28th | 1.73±0.00d | 1.59±0.00c | 1.56±0.00b | 1.53±0.00a | \* |
| Total FCR (1st-28th) | 1.54±0.78d | 1.41±1.17c | 1.40±0.92b | 1.37±0.84a | \* |

T0= Control, T1= Control + 0.5% amla, T2= Control + 1.0% amla and T3= Control + 1.5% amla powder. abc means having different superscript in the same row differed significantly (P<0.05) \*= 5% level of significance, NS= Non significant.

**3.4 Meat yield characteristics**

Table.5 shows that group T3 had the greatest living weight (1496.11g), whereas groups T0 and T1 had the lowest live weights (1160.52g and 1340.41g), respectively, and that group T3 had the other weight (1365.49g), all of which are significant. Carcass weights were significant; dietary group T3 had the highest carcass weight (905.15g), while dietary group T0 had the lowest (668.55g). Significant differences were obtained for the percentage of breast meat and drumstick meat at different diets. Breast meat and drumstick meat of broilers almost increase in a linear fashion with the increase in amla levels. The tabulated result presents that amla levels had a marked influence on meat characteristics. Investigators found that while carcass characteristics such as shrinkage loss, blood loss, and relative heart weight stayed similar across treatments, feather loss, giblet, liver, gizzard, eviscerated yield, and dressed yield decreased [13]. Our findings were similar to those of other studies [4,5,14,18,23,19].

**Table.5: Effect of feeding amla to broilers on carcass characteristics at different ages**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Dietary groups (%)** | **Level of significance** |
| **T0** | **T1** | **T2** | **T3** |
| Live weight | 1160.52±0.51a | 1340.41±0.62b | 1365.49±0.68c | 1496.11±0.60d | \* |
| Carcass weight | 668.55±0.34a | 799.30±0.19b | 847.76±0.34c | 905.15±0.59d | \* |
| Breast weight | 267.12±0.39a | 321.92±0.47b | 381.08±0.58c | 390.41±0.38d | \* |
| Thigh weight | 203.32±0.63a | 233.48±0.65b | 252.17±0.82c | 272.09±0.56d | \* |
| Head Weight | 33.62±0.37a | 36.21±0.22b | 38.04±0.58c | 38.17±0.22c | \* |
| Shank weight | 40.51±0.49a | 44.07±0.57b | 45.68±0.20c | 49.09±0.59d | \* |
| Gizzard weight | 42.04±0.63b | 39.24±0.45a | 39.13±0.60a | 40.33±0.79ab | \* |
| Liver weight | 34.00±0.52a | 32.09±0.55b | 35.21±0.56b | 37.42±0.66c | \* |
| Heart weight | 4.98±0.07a | 5.67±0.01a | 6.53±0.08b | 6.69±0.50b | \* |
| Spleen weight | 2.20±0.05ab | 2.04±0.02a | 2.33±0.00bc | 2.52±0.10c | \* |
| Intestine weight | 113.00±1.57b | 99.73±1.72a | 98.79±0.33a | 115.26±0.38b | \* |

T0= Control, T1= Control + 0.5% amla, T2= Control + 1.0% amla and T3= Control + 1.5% amla powder. abc means having different superscript in the same row differed significantly (P<0.05) \*= 5% level of significance, NS= Non-significant.

**4. Fecal microbial load**

Table.6 illustrates the effect of amla powder on the microbial load count in faeces. T0 had the highest *E. coli* load (228.12±1.70), followed by T1 (192.33±0.47), T2 (179.40±0.77), and T3 (153.53±0.80). The highest *Salmonella sp.* load also had T0 (173.02±2.20), with values of T1 (153.53±0.80), T2 (168.39±1.07), and T3 (161.51±0.49), respectively. It is probable that intermediate nutrition metabolism has a strengthening effect on gut flora [5,8,11]. Furthermore, it has been hypothesized that amla powder activates these glands and reduces bacteria, therefore increasing the haemato-biochemical profile, digestibility, and FCR.

**Table.6: Fecal microbial load**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameters | T0 | T1 | T2 | T3 | **Level of Significance** |
| *E. coli* (CFU/ml) | 228.12±1.70a | 192.33±0.47b | 179.40±0.77c | 147.05±0.72d | \*\* |
| *Salmonella sp* (CFU/ml) | 173.02±2.20a | 153.53±0.80c | 168.39±1.07b | 161.51±0.49c | \*\* |

T0= Control, T1= Control + 0.5% amla, T2= Control + 1.0% amla and T3= Control + 1.5% amla powder. abc means having different superscript in the same row differed significantly (P<0.05) \*= 5% level of significance, NS= Non-significant.

**5. CONCLUSIONS**

As a result, supplementing with amla powder improved carcass features, reduced microbial burdens, and increased growth performance (P<0.05). Overall performance and quality were enhanced with an additional 1.5% of amla powder. Therefore, it might be advised to add a 1.5% ml amla powder supplement during broiler production.

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**AUTHORS’ CONTRIBUTIONS**

This work was carried out in collaboration among all authors. Author MGA performed research work, collected data, and performed the statistical analysis. Authors MK and TY designed the study and the protocol and supervised the study. Authors AS, AAMK and EA managed the literature searches and microbial count. Author MAJ wrote and wrote the first draft of the manuscript, statistical analysis and microbial count. Authors MSS and MSHmanaged the literature searches All authors read and approved the final manuscript.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist

**DISCLAIMER OF ARTIFICIAL INTELLIGENCE**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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