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Broiler Chicken Performance on a Diet Complete with Clove (Syzygium Aromaticum) Powder

Running Title: *Effect of Clove on broiler chicken.*

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Abstract: ***Background and Objective: Antibiotic side effects are a serious concern. On the other hand, clove is well known for its medicinal benefits and is widely accessible in local markets. Therefore, this study was done to see if clove could replace antibiotics. The objective of the current study was to evaluate how different dietary supplementation doses of clove powder affected body weight, growth rate, feed intake, feed conversion efficiency, carcass characteristics, and the economics of broiler chicken production. Materials and Methods: A total of 200 - day - old Cobb 430 Y commercial broiler chicks were randomly divided into four treatments (T1, T2, T3, and T4), each with five replications of ten birds. These treatments were all carried out using a Randomized Block Design. The test animals were fed a typical broiler starter (0–21 days) and finisher (2–42 days) meal. Four dietary regimens containing 0, 0.5, 1.0, and 1.5 g/kg of feed were given to the birds. Weekly records of body weight, weight increase, and FCE were kept, while daily records of total daily calorie consumption were kept. Four birds from each treatment were slaughtered on the 42nd day in order to examine the corpse's characteristics. Results: The addition of clove powder to the meal had no discernible impact on body weight or weight increase, and T4 feed intake had the best FCE ever reported. The clove supplementation group had no deaths. Hence it was noted that the area was entirely livable. Clove supplementation had little influence on carcass weight; however, it had a noticeable impact on dressing % and organ weights. The maximum BCR and net profit per bird were found in T3. As a result, T3 was shown to have the highest performance index, net profit per bird, and BCR. As a result of the aforementioned findings, supplementing feed with clove powder at 1.0 g/kg can be advised given the agroclimatic conditions in Nagaland.***

Keywords: Broiler chicken, Clove powder, Growth performance, Organ Weight, Performance index.

1. Introduction

With an annual growth rate of 8%, poultry is one of the agricultural sectors in India that is expanding the fastest. India is the third - and seventh - largest producer of chicken meat and eggs in the world, respectively (2015 Watt Executive Guide). Each year, 260 million hens produce around 3.4 million metric tonnes (74 billion) of eggs, while 3000 million broilers create about 3.8 million metric tonnes of poultry meat. The least organized sector in animal agriculture, the chicken business contributes over Rs.70, 000 crores to the national GDP and employs over 4 million people. (Chatterjee and Rajkumar, 2015). Consumption of eggs per person has climbed from 30 to 68, while consumption of chicken has increased from 400 g to 2.5 kg. This business has become one of the most significant economic activities not only in India but also in countries like the USA, China, and Brazil. Due to its quick returns, reduced area requirements, earlier marketing age, and higher weight increase, broiler production is typically prioritized by farmers. The development of poultry resources in the Northeastern states is slower than in other areas. The North East region is home to 435.34 lakh poultry, or 5.97% of all chickens in India, according to the 19th livestock census of 2012. In the North East area, Assam accounts for 63% of all poultry populations, with Tripura and Meghalaya following closely behind at 10% and 8%, respectively. Assam produces the most eggs (55%), followed by Tripura (11%), Nagaland (9%), and the rest of India (2% of total egg production in India in 2005–2006). (Sheikh *et al.*, 2010).

Producing poultry meat and eggs that are both inexpensive and of excellent quality is highly desired. There is a tremendous demand for the production of inexpensive, premium poultry meat and eggs without the use of antibiotics or other growth promoters in chicken feed or water. Herbs and spices have been demonstrated to be effective replacements in this regard for promoting the growth and health of poultry birds. In order to increase production and improve the quality of the food that is produced, photogenic feed additives are typically things made from plants that are added to animal feed for fattening. The action of the antibacterial created by feed additions from plants has been proven to control the pathogenic microbiota in animals' gastrointestinal tracts, decreasing mortality rises throughout the fattening period, especially during stressful times. Because they improve the flavour and aroma of the feed, plant - based additives are routinely added to animal feeds, which encourage animals to consume it and thrive. Black pepper, tulsi, and clove plant extracts are used as growth promoters in chicken feeds because they have the potential to be anti - oxidative. They have lower manufacturing costs, a lower danger of toxicity, and fewer health risks because of their adaptability and predilection. One of the most expensive spices, clove (Syzygium aromaticum), has been used for ages as a food preservative and for a variety of therapeutic uses. Beta - carotene, vitamin A (retinol), vitamin K, vitamin B6, vitamin B1, and vitamin C are all found in cloves (Dorman *et al.*, 2000; Nadkarni, 2000). The most important component of cloves is a phenolic molecule called eugenol, which accounts for 72%–90% of their bioactivity. Due to its high antioxidant and

antibacterial properties, which distinguish it from other spices, clove has drawn attention.

It's noteworthy that recent biological studies using particular herbal preparations as growth boosters have produced encouraging outcomes. Some of the publications claim that improvements have been made in the weight growth, feed efficiency, mortality rate, immunity level, and liveability of poultry birds. Furthermore, research has shown that these natural growth promoters can treat liver damage brought on by feed contaminants such aflatoxin (Ghosh, 1992). Robenorst *et al., (*1996) and, Ouattara *et al.* (1997), others have utilized clove as an antiseptic, analgesic, and local anaesthetic. Additionally, it is antifungal (Velluti *et al*., 2003), antipyretic, and antiparasitic (Kim *et al.*, 2004), as well as an antioxidant (Lee and Shibamoto, 2003), and has an appetizing and stimulating impact on digestion. Clove extract is frequently employed in the food sector due to its distinctive aroma and inherent safety, according to various studies on current biological experiments of specific herbal formulations as growth accelerators.

Due to their antibacterial properties, phenolic chemicals like eugenol, thymol, and carvacrol are added to animal feed. Clove extract contains eugenol, which has a significant amount of antibacterial action in vitro. According to Najafi and Torki (2010), clove extract has been shown to be effective in poultry for enhancing growth performance, controlling some intestinal pathogens, acting as an antiseptic and a digestion stimulant, as well as having potent antimicrobial and antifungal, anti - inflammatory, anaesthetic, anti - carcinogenic, antiparasitic, and antioxidant effects. According to Toghyani *et al*. (2011), Cinnamaldehyde and eugenol exhibit inhibitory effects on Aspergillums flavor as well as antibacterial activity against a variety of microorganisms. Clove powder (0.1 - 2.5 g/kg diet) had a favorable impact on broiler chickens' growth performance, feed efficiency, and alterations in the gut epithelium, according to Agostini *et al*., (2012). On the other hand, broiler chickens' health was improved when clove powder at inclusion levels of 1.0 and 1.5 g per kg of feed was given to them (Mahrous *et al*., 2017). However, when ingested in quantities less than 1.5 g/kg, the clove is a safe plant (Cortes - Rojas *et al.*, 2014). The study "Performance of broiler chicken on a diet supplemented with clove (Syzygium aromaticum) powder" has been taken up in light of this.

2. Materials and Methods

The goal of the current study was to determine the impact of adding clove (Syzygium aromaticum) powder to the diet on the broiler rearing economy, growth pattern, feed intake, feed conversion efficiency, carcass characteristics, mortality, and liveability.

1.1 Treatment and Feeding

Two hundred day - old chicks were assigned at random into four treatment groups, each with fifty chicks and five replications of ten chicks each. The chicks were raised for their first 21 days in a deep litter brooder house and for their last 21 days in a finisher housed in cages. From 1 - 3 weeks of age, the chicks were fed a normal broiler starter, and from 4 - 6 weeks of age, a broiler finisher. Group 1 (T1) was given the basal diet and acted as the control group. The chicks in the other three treatment groups received the same basic meal as T1 but with varying amounts of clove powder added. The chicks in the other three treatment groups received the same basic meal as T1 but with varying amounts of clove powder added. Table 1 summarises the specifics of the distribution of chicks and their care.

1.2 Body Weight and Growth Rate

Initial body weight of the day - old chicks was recorded. Thereafter, the average body weight of the broiler chicks was recorded on weekly basis which was taken in the morning hours prior to feeding and watering. A digital weighting balance having a minimum capacity of 10 kg was used for the entire experiment for weighing the birds. During the first three weeks, the average weight of the chicks was recorded in group of 10. This was done by placing 10 chicks each in pre - weighted thermocol box. After 21 days, the birds were weighed two each at weekly intervals till they attained six weeks of age i. e.42 days of age.

1.3 Feed Intake and Feed Conversion Efficiency

Throughout the study, food and water were freely available to all of the groups. The amount of food supplied to the birds each day was logged, along with any leftover feed for the next morning. The number of calories consumed was calculated using an accurate digital weighing balance and weighed feeds provided in accordance with treatments. The remaining feed was subtracted from the total amount of feed provided the previous day in order to calculate the precise amount of feed consumed by the birds each day. These results were used to calculate the average and weekly feed consumption expressed in grams for each bird in each group. The following formula was used to determine the feed conversion efficiencies (FCEs) of several experimental groups.

$$\text{Efficiency (FCE)} = \frac{\text{Quantity of feed consumed (g)}}{\text{Total body weight gain (g)}}$$

1.4 Mortality / Liveability and Performance Index

Throughout the course of the experiment, mortality was calculated daily and expressed as a percentage. The following formula was used to determine the mortality.

$$\text{Mortality (\%)} = \frac{\text{Total no. of birds died}}{\text{Total no. of live birds}} \times 100$$

The liveability percentage was calculated by subtracting the mortality percentage from 100. The formula from Birds (1955) was used to calculate the performance index (PI):

$$\text{PI} = \frac{\text{Average body weight (g)} \times \text{\% livability}}{\text{Cumulative FCE} \times \text{No. of days}} \div 10$$

1.5 Dressing Percentage, Carcass Yield and Organ Weight

At the end of the trial, three birds from each group were chosen at random to be utilised in carcass evaluation studies. Each bird's live weight was recorded before it was killed. The animals were slaughtered with the Kosher Method. After the bird had completely bled and had its feathers removed, the dressed weight of the bird was determined. Additionally weighed separately were the heart, liver, spleen, and gizzard (empty), and for each of the four groups, the average weight of each of these organs was noted. The following calculation was used to compute the percentage of dressed weight.

$$\text{Dressing (\%)} = \frac{\text{Dressed weight (g)}}{\text{Live weight (g)}} \times 100$$

1.6 Statistical Analysis

The experiment's results were statistically analysed using ANOVA in a Completely Randomised Design, as outlined by Snedecor and Cochran (1998), in order to provide a meaningful interpretation and determine the impact of various treatments on various parameters.

3. Results

2.1 Weekly Body weight

The average body weight of the broiler chicks on the day of arrival was recorded as 0.045, 0.044, 0.043 and 0.044 kg per bird for T_1, T_2, T_3 and T_4 respectively. The corresponding weight of the birds in the 6th week of age 2.410, 2.408, 2.354 and 2.360 kg/bird. The overall mean body weight was 1.012±, 1.017±, 0.997± and 1.017± kg/bird/week in T_1, T_2, T_3 and T_4 respectively.

2.2 Gain in body weight

The total weight gained during the period it was noted as 2.393, 2.407, 2.358 and 2.358 kg/week/bird for T_1, T_2, T_3 and T_4, respectively. The average weight gained during the study for T_1, T_2, T_3 and T_4 were 0.398±, 0.401±, 0.393± and 0.393± respectively.

2.3 Feed intake

The total feed intake during the entire period for the experiment for T_1, T_2, T_3 and T_4 were 4.316, 4.305, 4.194 and 4.295 per bird, respectively.

2.4 Feed Conversion Efficiency

The overall mean feed conversion efficiency of broiler birds in different groups was as 1.753±, 1.749±, 1.737± and 1.749± in T_1, T_2, T_3 and T_4 groups, respectively.

2.5 Mortality/Liveability and Performance Index

In the present study, mortality was recorded as, 4.16, 2.04, 0.00 and 2.04 per cent in T_1, T_2, T_3 and T_4 group, respectively. The performance index for T_1, T_2, T_3 and T_4 group was calculated as 309.29, 320.98, 314.45 and 320.99, respectively.

2.6 Dressing percentage, Carcass yield and Organ weight.

At the end of 6th week of age three birds from each treatment groups were taken for the study of carcass characteristics. The average dressing percentage of broiler birds at the end of sixth week was 76.33, 75.89, 78.08 and 77.06 in T_1, T_2, T_3 and T_4 groups, respectively. The weight of gizzard, heart, liver and spleen was included for calculating dressing percentage. Variation in the values can be noted in the different treatment groups. The highest dressing percentage was recorded in T_3; group followed by T_4, T_1 and T_2 groups respectively. The average carcass weight of broiler birds was recorded as 1.93, 1.92, 1.90 and 1.97 kg/bird for T_1, T_2, T_3 and T_4 groups respectively. The average weight of carcass was highest in T_4 followed by T_1, T_2 and T_3 groups. The average heart weight was recorded as 16.4, 16.6, 19.4 and 18.3 g/bird for T_1, T_2, T_3, T_4 and T_5 groups, respectively. The heart weight was highest in T_3 group followed by T_4, T_2 and the lowest in T_1 group.

4. Discussion

From the data it was revealed that the values of average body weight differ significantly up to 3rd week of experimental period and in 3rd week body weight was significantly ($P<0.05$) higher in T_2 group followed by T_3 and T_1 and least in T_4 group. With the advancement of age, the birds grew; however, the final body weight of bird did not differ irrespective of treatment groups. The findings of the present study were well corroborated with the observation of Barreto e*t al.* (2008), Marcincak *et al.* (2011), Mukhtar (2011), Petrovic e*t al.* (2012) and Salman and Ibrahim (2012) who had also reported a non - significant.

From the result, it has revealed that the values of average gain in weight differ significantly till 3rd week and during the 5th week of experimental period and was significantly ($P<0.05$) higher in T_2. With the advancement of age, the birds grew; however, the overall values of gain in weight in boiler birds showed no effect irrespective of treatment. Kichu *et al (*2023) who also reported significant body weight gain when they incorporated turmeric on a birds diet. The findings of the present study were well corroborated with the observation of Mukhtar *et al.*, (2011) contrarily, gain in weight of broiler birds was significantly ($P<0.05$) higher on diet supplemented with clove as compared to control group Ertas *et al.*, (2005); Dalkilic and Guler., (2009); Nath e*t al., (*2012); Salman and Ibrahim, (2012).

The overall feed intake mean were 0.719±, 0.717±, 0.699± and 0.715± kg/bird/week. The findings of the present study were well corroborated with the results of Muktar (2011), Petrovic *et al.*, (2012) and Salman and Ibrahim (2012) who had also reported dietary supplementation of clove at different levels had no effects on feed consumption of broiler chicken. Contrarily, feed intake of broiler birds was significantly ($P<0.05$) higher on diet supplemented with clove as compared to control group. Ertas e*t al.*, (2005), Mehr e*t al.*, (2014).

The finding of the present study was well corroborated with the finding of the other workers, Nath *et al., (*2012) and Mahrous e*t al*., (2017) who had also observed that FCE of broiler birds had no effect on different groups. Contrarily, to this observation Barreto e*t al*., (2008), had observed that feed conversion efficiency values were better on diet supplemented with different levels of clove as compared to control group. The difference in the observation in the present study might be due to level and species of clove, birds and agroclimatic condition of the study area.

The performance index for T_1, T_2, T_3 and T_4 was calculated as 309.29, 320.98, 314.45 and 320.99 respectively. Numerically the best performance index was found in T_4, T_2, T_3 and least in T_1 group. However, there was non - significant difference in the different treatment groups on performance index. Variation in the result might be due to difference in the variety of clove, its levels of use in the diet, species differences of the broiler birds and agro - climatic of the experimental site.

The finding of the study was well corroborated with the observation of Mukhtar (2011) who had also reported that dietary supplementation of clove oil in the broiler diet at different level lowered the mortality rate as compared to control group. Contrary to this, Barreto *et al., (*2008) Dalkilic and Guler (2009), observed that the mortality was higher in the group supplemented with clove powder as compared to the control group.

The average weight of the liver per bird for the T1, T2, T3, and T4 groups was 58.8, 52.1, 67.4, and 57.3 g, respectively. T3 had the largest liver weight, followed by T1, T4, and T2, who had the smallest liver weight. For the T1, T2, T3, and T4 groups, the average spleen weight was 3.6, 3.0, 4.0, and 3.3 g/bird, respectively. The T3 group had the largest spleen weight, followed by the T1 group, the T4 group, and the T2 group. According to the findings, the lower level (0.5 g/kg) diet supplemented group's dressing % values were superior to those of the control group. The percentage of dressing, however, did not follow a linear pattern, i. e., an upward trend with an increase in the amount of clove powder in the broiler chicken diet. However, the value was numerically highest in the T3 group with the level of clove powder supplementation at 1.0 g/kg feed level.

5. Conclusions

The overall live weight of the broiler birds was the highest (2.410 kg/bird) in the T_1 group of birds with basal diet. Treatment group T_2 (2.408 kg/bird) was the highest in live weight and gain in live weight among the groups supplemented with clove powder. The greatest feed consumption was noted in T_1 group with a value of 4.316 kg/bird at the end of 6^{th} week. T_3 with better feed conversion efficiency (1.737 as compared to other treatment groups). The liveability of the birds was the highest in T_3 (100 per cent) and the lowest in T_1 (95.16) groups respectively. The performance index was the best in T_4 (320.99) as compared to control (T1) and other supplemented groups (T_2 and T_3). The highest dressing percentage was found in T_3 (78.08 per cent) as compared to other levels of supplementation or without supplementation. According to the findings of the current study, supplementing clove powder at different levels did not significantly affect the broiler birds' performance in terms of body weight, weight gain, feed intake and FCE, overall performance index, carcass characteristics, or net profit per bird under Nagaland's agro - climatic conditions.

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Conflict of Interest: None.

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Table and Figure

Table 1: Details of distribution of chicks and their treatment.

Group	Basal Diet	Clove powder	Dose	Duration (days)
T_1	Starter Mash	None	None	0 - 21
	Finisher Mash	None	None	22 - 42
T_2	Starter Mash	Clove powder	0.5 g/kg. feed	0 - 21
	Finisher Mash	Clove powder	0.5 g/kg. feed	22 - 42
T_3	Starter Mash	Clove powder	1.0 g/kg. feed	0 - 21
	Finisher Mash	Clove powder	1.0 g/kg feed	22 - 42
T_4	Starter Mash	Clove powder	1.5 g/kg feed	0 - 21
	Finisher Mash	Clove powder	1.5 g/kg feed	22 - 42

Table 2: Average body weight (kg/bird/week) of broiler birds in different treatment groups.

Treatment	Weeks							Total	Mean
	0	1st	2nd	3rd	4th	5th	6th		
T_1	0.045	0.144^b	0.441^a	0.896^b	1.307	1.841	2.410	7.084	1.012
T_2	0.044	0.138^a	0.442^a	0.900^c	1.309	1.877	2.408	7.118	1.017
T_3	0.043	0.138^a	0.445^b	0.896^b	1.297	1.809	2.354	6.982	0.997
T_4	0.044	0.145^b	0.442^a	0.884^a	1.355	1.888	2.360	7.118	1.017
SEm		0.007	0.006	0.008	0.017	0.020	0.038		
CD (P=0.05)		0.021	0.0019	0.025	0.055	0.064	0.11		

[a, b, c] Means bearing different superscripts in a column differ significantly (P<0.05).

Table 3: Average gain in body weight (kg/bird/week) of broiler birds in different treatment groups.

Treatment	Weeks						Total gain	Mean
	1st	2nd	3rd	4th	5th	6th		
T_1	0.099^b	0.342^a	0.445^b	0.411	0.528^a	0.568	2.393	0.398
T_2	0.094^a	0.348^b	0.458^d	0.409	0.568^b	0.530	2.407	0.401
T_3	0.095^a	0.350^b	0.451^c	0.406	0.512^a	0.544	2.358	0.393
T_4	0.101^b	0.341^a	0.442^a	0.471	0.532^a	0.471	2.358	0.393
SEm	0.0008	0.0012	0.0008	0.018	0.010	0.031		
CD (P=0.05)	0.0025	0.0039	0.0026	0.057	0.031	0.097		

[a, b, c] Means bearing different superscripts in a column differ significantly (P<0.05).

Table 4: Average feed intake (kg/bird/week) of broiler bird in different treatment groups

Treatment	Weeks						Total	Mean
	1st	**2nd**	**3rd**	**4th**	**5th**	**6th**		
T_1	0.149^b	0.441	0.739^a	0.917	1.054^b	1.016	4.316	0.719
T_2	0.146^{ab}	0.442	0.746^b	0.921	1.058^b	0.992	4.305	0.717
T_3	0.148^b	0.439	0.747^b	0.887	1.009^a	0.964	4.194	0.699
T_4	0.144^a	0.441	0.738^a	0.932	1.029^a	1.011	4.295	0.715
SEm	0.0008	0.0007	0.0008	0.010	0.011	0.012		
CD (P=0.05)	0.0025	0.0024	0.0025	0.032	0.036	0.039		

[a, b, c] Means bearing different superscripts in a column differ significantly (P<0.05).

Table 5: Average feed conversion efficiency of broiler chicken in different treatment groups.

Treatment	Weeks						Total	Mean
	1st	2nd	3rd	4th	5th	6th		
T_1	1.510	1.289^b	1.660^b	2.268	1.998^d	1.793	10.518	1.753
T_2	1.563	1.269^a	1.628^a	2.257	1.864^a	1.914	10.495	1.749
T_3	1.548	1.253^a	1.656^b	2.212	1.969^c	1.787	10.425	1.737
T_4	1.433	1.293^b	1.669^b	1.995	1.934^b	2.172	10.496	1.749
SEm	0.015	0.005	0.003	0.088	0.028	0.031		
CD (P=0.05)	0.048	0.016	0.011	0.272	0.022	0.088		

[a, b, c, d] Means bearing different superscripts in a column differ significantly (P<0.05).

Table 6: Average mortality and liveability (%) percentage and performance index of broiler birds in different treatment groups.

Groups	Mortality (%)	Liveability (%)	Performance Index
T_1	4.16	95.16	309.29
T_2	2.04	97.96	320.98
T_3	0.00	100	314.45
T_4	2.04	97.96	320.99

Table 7: Average dressing percentage, carcass yield (kg) and organs weight (gm/bird) of broiler birds in different treatment groups.

Treatment	Dressing (%)		Carcass yield (kg)	Organ weight (g)			
	With edible	Without edible		Gizzard	Heart	Liver	Spleen
T_1	76.33	71.48	1.93	52.3	16.4	58.8	3.6
T_2	75.89	71.37	1.92	49.8	16.6	52.1	3.0
T_3	78.08	72.51	1.90	55.1	19.4	67.4	4.0
T_4	77.06	72.42	1.97	47.4	18.3	57.3	3.3

Figures

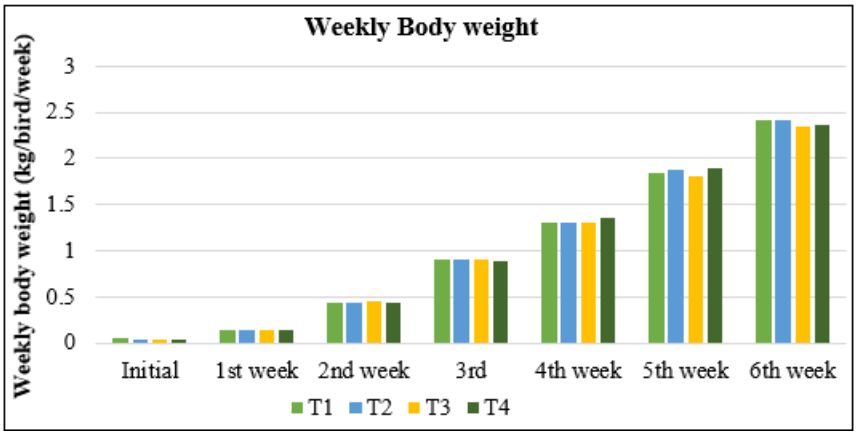

Figure 1: Weekly body weight (kg/bird/week) in different treatment group of broiler birds

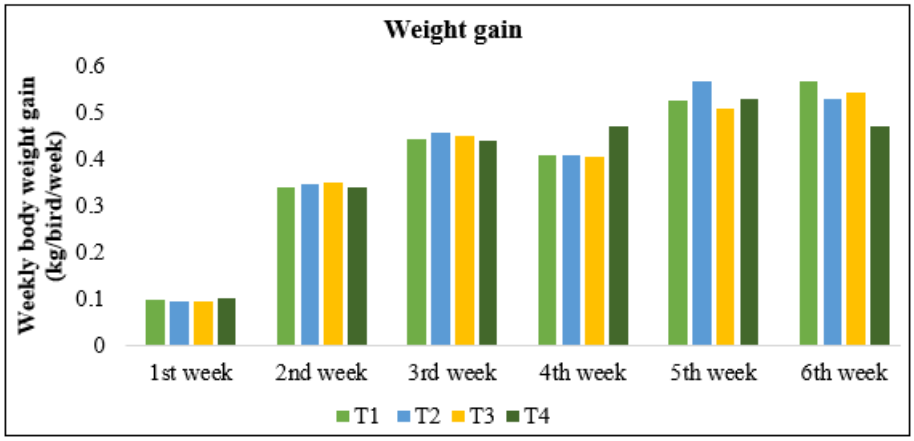

Figure 2: Weekly body weight gain (kg/bird/week) in different treatment groups of broiler birds.

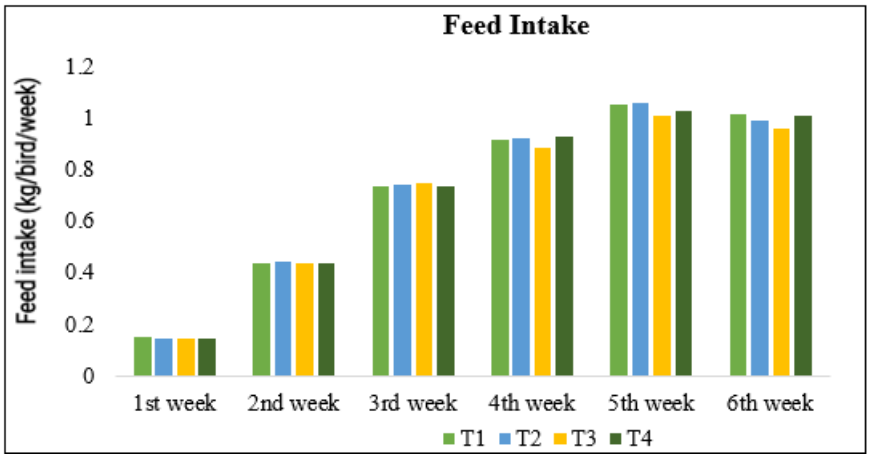

Figure 3: Weekly feed intake (kg/bird/week) in different treatment groups of broiler birds.

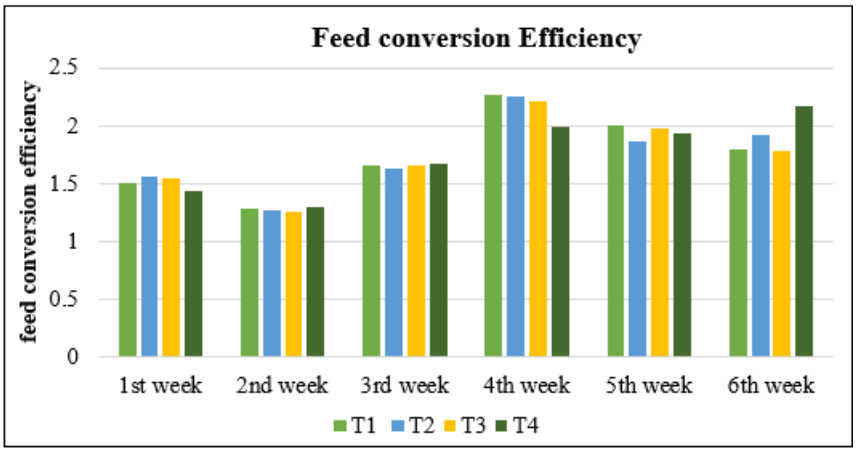

Figure 4: Weekly feed conversion efficiency in different treatment groups of broiler birds.