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Research Article

Growth Performance and Immune Response of Free-range Chicken Supplemented with Different Levels of Spirulina (*arthrospira platensis*) in their Diet

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ABSTRACT

The study was conducted to determine the effects on the growth performance and immune response of free-range chicken supplemented with different levels of spirulina in their diet. Sixty free range chicken, fifteen day-olds, were used in the study which were randomly distributed in four treatments, three replicates in each treatment with five experimental birds in each replicate. Treatment 1- Control (pure commercial feeds); Treatment 2- 4% spirulina supplemented in commercial feeds; Treatment 3 -5% spirulina supplemented in commercial feeds and Treatment 4 – 6% spirulina supplemented in commercial feeds. Initial and final weight reveal that they are replicate significantly different among the four treatments whereas Average Daily Gain and Feed Conversion Ratio showed no significant differences among treatments, however, Treatment 4 exhibited efficiency in feed conversion and has the highest gain in weight among treatments. In hemagglutination Inhibition test, all treatments responded positive in immune response.

Keywords: *agriculture, diet, experimental research, free-range chicken, Poultry Production*

Introduction

Free range chicken has become a popular household poultry raised in the backyard for household consumption or for commercial purposes. It has gained its niche both in the household and in the market because raisers have learned how to raise this commodity easy to manage given the right knowledge and resources that free-range chicken farming requires. There are different breeds of free-range chicken which can be raised for different purposes such as laying, for meat and for dual purposes.

Amidst this time of pandemic, households are into raising animals and free-range chicken is one of the many choices because it can be harvested in a short period of time. The broiler or meat type can be readily slaughtered at thirty-five days at the earliest, although this can be reared longer in the range to pasture for their own food along with the provisions given them. At a given period of rearing days, this

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breed of poultry can be provided with different kinds of greens from the abundance of the pasture for their food alongside with the commercial feeds they consume. These variety of greens are added food provisions that offer supplements for their health benefits. Other sources of greens can also be added to their diet as food supplement which could provide health benefits as it contains sorts nutrients.

One of the greens that is commonly found provided by nature is the spirulina which grows in fresh and salt water. Spirulina is a single-celled blue green alga rich in nutrients which naturally grow in ponds or lakes, however, can be cultured in ponds for the purposes of supplementation for humans or animals. Spirulina, as the term implies, is a spiral-shaped, single celled blue green beneficial bacteria which is highly nutritious and numerous health benefits as bared in frequent searches in the network, information found in the advertisements and levels from manufacturers of spirulina packages. Spirulina has become popular among health enthusiasts because of its health benefits and claims that this single-celled blue-green algae prevents health conditions or problems in humans. Likewise, there were studies using spirulina as supplement in livestock and poultry.

A pond was constructed for the propagation of feed grade spirulina following the protocols for production. Thus, this study using spirulina as supplement for free range chicken to find out their growth performance in response to this single-celled blue green alga.

The following are the objectives of the study: 1) to determine the growth performance of free range chicken added with different levels of dried spirulina in their diet in terms of final 2weight, gain in weight, average daily gain, feed conversion effieciency, and mortality rate and 2) to analyze the immune response of free-range chicken supplemented with different levels of dried spirulina using Hemagglutination Inhibition (HI) test.

Time and Place of the Study

The study was conducted on December 2020 to January 2021 at Santa Ignacia, Tarlac. Hemagglutination Inhibition Test was conducted at Regional Animal Disease Diagnostic Laboratory at Tarlac City.

Methods

Research Design

The investigation will be using experimental research design. A total of sixty fifteen-day-old free-range chicken were used in this study. The experimental birds were randomly distributed in four treatments with three replicates in each treatment wherein there were five experimental birds in each replicate. The study conducted using a simple Completely Randomized Design (CRD).

Management of the Experimental Animals

On the Housing

Three cages measuring five by ten feet each were used, and each cage was partitioned into four to make up twelve cages. Chicken wire was used as partition and flooring. Feeders and waterers were provided in each cage and labeled according to treatments.

On the Propagation and Collection of Spirulina

Spirulina were cultured and propagated in fabricated ponds located at Tarlac Agricultural University. Spirulina were propagated in the ponds with de-chlorinated water and aerator for the oxygen supply for the spirulina with the standard temperature of 35°C to 38°C with the use of thermometer to monitor. Spirulina needs plenty of sunlight and warmth to grow efficiently. Minerals like sodium bicarbonate, magnesium sulfate, potassium nitrate, citric acid, salt urea, calcium chloride, iron sulfate and ammonium sulfate were added to serve as food for the stocks. The spirulina multiplies after several days given the conducive weather condition and temperature. Collection can be done using a clean strainer and poured on a clean cloth to squeezed removing the water. The collected spirulina were then spread in a porcelain plate and put under the sun to dry until it become crispy.

On the Mixing of Different Treatments

Spirulina were mixed with commercial feeds in a clean basin according to treatment. A digital weighing scale was used to weight the spirulina to be mixed in the commercial feeds

as stated in the different treatments. The commercial feeds were likewise weighed according to treatment mixture with spirulina.

On Feeding of Spirulina-Supplemented Ration

Experimental birds were fed with the experimental supplementation of spirulina in their ration, according to treatment, at 8 o'clock in the morning and were provided with clean water every day from the start of the study until the last day of the experimentation with the duration of twenty-one days experimental feeding.

On Vaccination and Health and Health Management

The experimental birds were vaccinated with Newcastle Disease (B1B1) when they were 14 day-old which was then followed when the experimental birds were 21 day-old with New Castle Disease (La Sota) as booster shot.

On Blood Collection and Laboratory Test

Twelve experimental birds, one from each replicate, were randomly selected for the collection of blood for blood analysis. One milliliter of blood was collected from the medial metatarsal vein of each randomly selected experimental birds from each replicate as samples for Hemagglutination Inhibition test.

Data Gathered

The following gathered were gathered:

a. Initial weight (g) – this was obtained on the start of the study using a digital weighing scale to establish the baseline weight of the experimental birds.
b. Final weight (g) – this was obtained on the last day of the study using a weighing scale.
c. Average daily gain (g) – this was attained by subtracting the initial weight from the final weight and divided by the number of days that the experimental birds were fed with the supplemented ration.
d. Feed conversion ratio (g) – this was attained by getting the total feed consumed divided by the total gain in weight for a particular period.
e. Hemagglutination Inhibition (HI) test - this is a test wherein an amount of blood was drawn from the experimental animal to evaluate vaccine-induced antibody responses.

Data Analysis

Data obtained on the growth performance of the experimental birds were subjected to Analysis of Variance of the Completely Randomized Design> The result of the HI test was descriptively analyzed.

Results and Discussion

The results of the data gathered on the growth performance and immune response of the experimental birds given with different levels of spirulina are shown and discussed in this chapter.

On the Growth Performance

The results on the growth performance of free-range chicken supplemented with different levels of spirulina in their diet is shown in Table 1.

Table 1. Summary of means on the growth performance of free-range chicken supplemented with different levels of spirulina in the diet

Treatment	Initial Weight (Gram)	Final Weight (Gram)	Average Daily Gain (Gram)	Feed Conversion Ratio (Kilogram)
Treatment 1 (Control)	0.2253^{ab}	1.38^{bc}	0.0550^{a}	2.04^{a}
Treatment 2 (4% Spirulina)	0.2110^{b}	1.37^{c}	0.0550^{a}	1.97^{a}
Treatment 3 (5% Spirulina)	0.2193^{b}	1.44^{b}	0.0560^{a}	1.96^{a}
Treatment 4 (6% Spirulina)	0.2377^{a}	1.55^{a}	0.0587^{a}	1.90^{a}
Coefficient of Variance (%)	3.84 (%)	2.27(%)	3.71(%)	2.95(%)

Means with the same letter are not significantly different using 5% alpha error LSD

Initial Weight and Final Weight

Results of the study shown on Table 1 revealed the initial weight of the experimental birds wherein Treatment 4 (with 6% spirulina) had a mean of 0.2377 grams, Treatment 1 (Control, commercial feeds without spirulina) had a mean of 0.2253 grams, followed by Treatment 3 (with 5% spirulina) with a mean of 0.2193 and Treatment 2 (with 4% spirulina) which had a mean of 0.2110 grams. Analysis of Variance revealed that Treatment 4 is significantly different among all the treatments, however, Treatment 1 is significant over Treatments 2 and 3, which are not significant

Five 15-day-old broiler type free range chicken were distributed in each twelve cage which served as the experimental animals. Five birds were weighed at the same time and were put in the cage and after each twelve cages had been loaded with five birds. Random assignment of treatment -replicates of each cage were done objectively to observe impartiality.

The result of the final weight as shown in the table, Treatment 4 had a mean of 1.55, Treatment 3 had a mean of 1.44, Treatment 1 had a mean of 1.38 and Treatment 2 had a mean of 1.38. Analysis of variance revealed that Treatment 4 is significantly different among all treatments. Treatment 3 over Treatments 1 and 2 and Treatment 1 over Treatment 2, respectively.

As reported by Warren (1994), experiments were conducted to evaluate the nutritional value of the blue-green algae, *Spirulina platensis*, grown on a synthetic media. In the experiment at 3 weeks of age, the growth of the chicks fed 10 and 20% of spirulina was depressed, although feed efficiency was not affected. Although the growth of the chicks fed with spirulina the diets were not different from that of the chicks receiving the control diet, the birds receiving the 12% spirulina diet grew slower than the chicks fed all of the other spirulina diets.

According to Opoola and Makinde (2019), the final weight, body weight gain, feed intake and feed conversion ratio were significantly ($P < 0.05$) higher in spirulina-supplemented groups compared with the control group for both the starter and finisher phases. For the starter phase it was observed that chicks fed 12.00g/kg spirulina diet performed better in terms of body weight gain while chickens fed 6.00g/kg spirulina diet had the best performance in terms of body weight gain at the finisher phase.

Average Daily Gain

As shown in the table, Analysis of variance revealed no significant differences among the four treatments, however, numerically Treatment 4, with a mean of 0.0587, had the highest average daily gain followed by Treatment 3 with a mean of 0.0560 and the two other treatments which had both a mean of 0.0550.

Fathi *et al.* (2018) reported in their findings of their study that birds fed diets containing spirulina had useful impacts of the productive performance. Spirulina platensis showed good body weight at 38 days of age. The results was in line with the finding of recent study which stated that different levels of spirulina showed good body improved the live body weight of broilers. Also, dietary spirulina significantly improved the weight gain of chickens compared to the control group. The improved live body weight may be due to the absorption of minerals and vitamins. The body weight was significantly increased in the treatment groups fed with Spirulina diet from 7th days to 28th days old according to Jamil et al. (2015).

Feed Conversion Ratio

Result of Feed Conversion Ratio presented in the table revealed that all the treatments are insignificantly different from each other as proven by Analysis of variance. Means of the individual four treatments showed that Treatment 4 had the lowest at 1.90, Treatment 3 at 1.96, Treatment 2 at 1.97 and Treatment 1 at 2.04.

Fathi *et al*. (2018) in their study revealed that feed conversion significantly improved by inclusion of spirulina in broiler diets as compared to the control diet, this improvement may be related with the balanced microbial population in the gastrointestinal tract enhance the absorbability of dietary vitamins and minerals, which had a significant role in the performance and health of broilers (Mariey *et al*., 2012)

Hemagglutination Inhibition (HI) Test

Blood samples obtained from randomly selected experimental birds in each replicate were submitted and analyzed in Regional Animal Disease Diagnostic Laboratory in Tarlac City. Result of the HI test is shown on the table below.

Table 2. Result of Hemagglutination Inhibition Test for New Castle Disease (ND Titer)

Sample No.	Sample Identification	Newcastle Titer	Interpretation
1	1	1:256	Positive for Antibody
2	2	1:256	Positive for Antibody
3	3	1:512	Positive for Antibody
4	4	1:512	Positive for Antibody
5	5	1:256	Positive for Antibody
6	6	1:512	Positive for Antibody
7	7	1:256	Positive for Antibody
8	8	1:512	Positive for Antibody
9	9	1:256	Positive for Antibody
10	10	1:256	Positive for Antibody
11	11	1:512	Positive for Antibody
12	12	1:512	Positive for Antibody

Note: A Titer of 1:32 is a Protective Antibody Titer for ND
A Titer of > 1:16 is Positive for Antibody of ND
A Titer of < 1:16 is negative for Antibody of ND

The experimental birds were vaccinated with ND B1B1 and ND La Sota when they were 14 day-old and 21 day-olds, respectively. Blood was collected when they were 36 day-old or a day after the last feeding of experimental supplementation of different levels spirulina in their diet. Table 2 presented the result of Hemagglutination Inhibition test for Newcastle Disease which indicate that all samples are positive of antibody for New Castle Disease. The presence of antibody in their circulation is advantageous signal that the experimental birds are protected against New Castle Disease which was also observed during the growing period since there were no recorded untoward health conditions among the experimental birds and zero mortality. The vigorous condition of the experimental birds may also be attributed to the supplementation of different levels of spirulina in their diet since spirulina is loaded with nutrients.

According to Mirzaie *et al.* (2018) the results showed that supplementation of the diet with *Spirulina* decreased concentration of stress hormone and some serum lipid parameters while enhanced humoral immunity response and elevated antioxidant status whereas it didn't meaningfully affect performance characteristics. Nevertheless, feed conversion ratio was improved numerically but not statistically in broilers fed with 1% *Spirulina* under high ambient temperature.

Conclusion

Based on the results of the study, the supplementation of different levels of spirulina in the diet of free-range chicken showed significant differences in terms of initial weight and final weight, however, gain in weight and final weight are insignificantly different from each other, respectively. However, numerically analyzed, Treatment 4 (6% spirulina) gave the highest gain in weight, followed by Treatment 3, Treatment 2 and Treatment 1, respectively in descending order. Treatment 4 got the lowest Feed conversion ratio, which is considered the most efficient converter among all treatments. All treatments were, likewise, responsive to New Castle Disease vaccine for protection.

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