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## EFFECTS OF SPIRULINA (*Spirulina platensis*) ON PRODUCTION, HEMATOLOGICAL PARAMETERS AND LIPID PROFILE IN LAYERS

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### ABSTRACT

The experiment was conducted to evaluate the effects of spirulina on production, hematological parameters and lipid profile in layers. Thirty (30) layer birds of 65 weeks of age were randomly divided into three groups (A, B and C) containing 10 birds in each group. Birds were subjected to treatments for a period of 1 month (30 days) as per following schedule: Group-A treated with 2gm spirulina/kg feed; Group-B: treated with 4gm spirulina/kg feed and Group-C: without any treatment. With the supplementation of spirulina, feed consumption and body weight were not affected, but egg production was increased significantly. Results showed that total erythrocyte count (TEC), haemoglobin concentration and packed cell volume (PCV) were significantly higher ( $P<0.05$ ) in treated groups compared to control. Serum total cholesterol (TG), triglyceride (TC) and low density lipoprotein (LDL) cholesterol were significantly decreased, as well as HDL was increased ( $P<0.05$ ) with addition of the increasing rate of spirulina supplemented groups (2gm and 4 gm.) than the control group. Overall, this work suggests that spirulina has a positive effect on egg production and explores the perspective use of spirulina improves haematological parameters and lipid profiles in layer birds.

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## INTRODUCTION

The poultry sector is an integral part of farming systems and has created both direct and indirect employment opportunity, improved food security and enhanced supply of quality protein to people's meals. Poultry meat and egg are the important sources of protein. Layer birds are produced specifically for egg production. In poultry production, the conventional feedstuffs have a tremendous increase in prices; this is attributed to the insufficient supply and food-feed competition. Therefore, evaluating new energy and protein resources for poultry is having the major interest among researchers and producers as well (Danny *et al.*, 2016). In this regard, the microalgae biomass represents a high potent feed option for animals; it was reported that around 30% of the world algal production is destined for animal feeding (Spolaore *et al.*, 2006; and Zahroojian *et al.*, 2013).

*Spirulina* (*Spirulina platensis*) is a multicellular filamentous blue green microalgae (cyanobacteria) known for its potential to bring about a nutritional revolution in the developing countries, where it grows naturally in highly alkaline lakes. (Maruti S 1993). It is an excellent food source, providing the highest amount of proteins (65-71%) with all essential and non-essential amino acids as well as various vitamins and minerals including the vitamin B complex and chelated minerals in balanced proportion along with the pigments ( Venkataraman 1993). *Spirulina* is one of the blue-green algae rich in protein 62.84% and contains a high proportion of essential amino acids (38.46% of the protein) and a source of naturally rich in vitamins especially vitamin B complex such as vitamin B12 (175 µg / 10 g) and folic acid (9.92 mg / 100 g). *Spirulina* contain selenium element (0.0393 mg/100 g) and many of the phytopigments such as chlorophyll and phycocyanin (1.56% and 14.647%), and those seen as a powerful antioxidant (Sharoba, 2014).

*Spirulina* contains a wide spectrum of prophylactic and therapeutic nutrients that include B-complex vitamins, minerals, proteins, γ-linolenic acid and the super anti-oxidants such as β-carotene, vitamin E, trace elements and a number of unexplored bioactive compounds. *Spirulina* consumption appears to promote the growth of intestinal micro flora as well (Kulshreshtha *et al.*, 2008).

Considering the high cost of the medicaments, alternative treatments for the control of the hypercholesterolemia have been used in the popular medicine as the ingestion of capsules of poly-unsaturated fatty acids or fruits and vegetables extracts that present substances with antioxidant potential, as the eggplant and the mate (Schinella *et al.*, 2000). The cyanobacterium *Spirulina* is cultivated and commercialized worldwide due to its nutritional characteristics including high concentrations of protein (~65%), vitamins and mineral salts (Belay *et al.*, 1993). Preparations of *Spirulina* are also used for their therapeutic properties in the treatment of many diseases, including hypercholesterolemia and atherosclerosis (Nakaya *et al.*, 1988).

*Spirulina* was reported to increase the poultry health, improve livability, and enhance the immune function (Kanagaraju P *et al.*, 2016). *Spirulina* has been demonstrated to be an effective dietary source of vitamin A. An investigation in India on preschool children with vitamin A deficiency demonstrated that the bioavailability of carotenes from spirulina was comparable to that from other sources such as carrots and green leafy vegetables thereby suggesting the potential use of spirulina as a dietary source of vitamin A (Annapurna *et al.*, 1991). The research work about spirulina in layer birds were not conducted yet but some experiment was occurred in other animals.

The present research work has been carried out to study the growth performances of layer birds evaluating weight gain and egg production, and to study the effects of *Spirulina platensis* of lipid profiles (TG, TC, LDL and HDL) and hematological parameters (Hb, TEC, PCV).

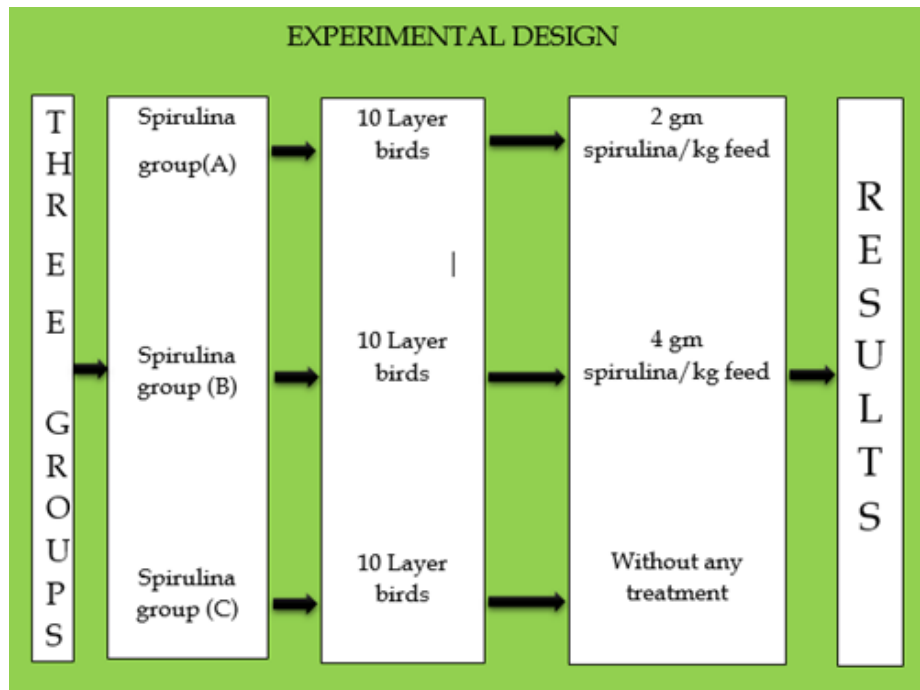
## MATERIALS AND METHODS

The experiment was carried out in the, Department of Pharmacology of Bangladesh Agricultural University (BAU), Mymensingh in collaboration of Department of Physiology and Pharmacology of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur.

### Experimental design

The experiment was conducted on 30 Rhode Island Red (RIR) birds (65 weeks of age) weighing about 1500-1600 g maintained on standard pellet diet and drinking water. The Birds were collected from the Diamond Bangladesh Ltd, Dhaka. Birds were kept in a compartment rectangular metallic cage wrapped with wire mesh. The bird's cages were kept in a well-ventilated farm with relative humidity of 70-80% and room lighting consisted of alternate 12 hours' light and dark period. All the birds were kept under close observation in order to maintain good health for conducting

experiment properly. After observation, all the 30 birds were randomly divided into three (03) equal groups. Each group comprising of 10 birds and were marked as group A, B, and C. All birds were subjected to be administered with normal feed and water of which, Group A was treated with supplemented spirulina (2gm/kg feed), Group B with supplemented spirulina (4gm/kg feed) and group C without any supplementation for a period of thirty days. Layer birds of control and treatment groups were weighed with spring weighing machine. At the end of the experiment birds were sacrificed to collect samples for analysis.



**Figure 1.** The experimental layout of research groups

#### Performance traits

Daily feed intake, egg production and weekly basis body weight was recorded

#### Sampling of blood

For the study of hemato-biochemical parameters blood samples were collected at 30 days of the experiment from the wing vein of all the groups in two tubes, in which one was heparinized for the study of hematological parameters and another one was non- heparinized for biochemical studies. All of the samples were transferred into the laboratory as quick as possible in ice.

#### Hematological studies

The haematological parameters were determined as per method cited by (Lamberg and Rothstein, 1977). Following parameters were observed; Estimation of haemoglobin (Hb), Determination of total erythrocyte count (TEC), Determination of packed cell volume (PCV).

#### Biochemical studies

The samples were left to clot and then centrifuged at 3000 rpm for 15 min, and the serum is collected. Serum was kept frozen at  $-20^{\circ}\text{C}$  until it was used for the biochemical analysis. Total cholesterol, triglyceride and HDL values were determined using the by Biochemistry Humalyzer-3000 (Human type, Germany) according to the technique described by Trinder (1969). The result was expressed in mg/dl. The LDL was determined by subtracting the HDL cholesterol value from the subtracted value of triglyceride from total serum cholesterol that was divided by five.

### Statistical analysis

The hematological and biochemical parameters of layers in corresponding to the different levels of Spirulina @ 2gm & 4 gm supplementation are compared and performing by Student t' Test (SPSS, 16 version).

## RESULTS AND DISCUSSION

### Effects of *Spirulina platensis* on performance traits

Table 01 shows the values of Feed intake, Egg production and the body weight. Among the parameters, feed consumption and body weight did not vary significantly with the control group, but the egg production found highest in group B followed by group C and A that is statistically significant with control group.

In this experiment, average egg production was significantly ( $P < 0.05$ ) increased in group B compared with the group A and group C respectively which has also reported by other researchers (Mariey *et al.*, 2012) who found that egg production was significantly ( $P < 0.05$ ) improved by dietary treatment with Spirulina sp. Few other authors also reported that laying hens fed Spirulina sp containing diets attained the best means of egg production compared with those of the control groups ( Ross *et al.*, 1994) and (Nikodémusz *et al.*, 2010). In contrast, observed that decrease in feed intake and no effect on the overall egg production with higher levels of Spirulina sp (Halle *et al.*, 2009).

**Table 1.** Effects of spirulina on feed consumption and egg production in layers

Performance Parameter	Mean $\pm$ SD			Level of Significance
	Group C (Control)	Group A (Spirulina 2gm)	Group B (Spirulina 4gm)	
Feed consumption (gm)	976.8 $\pm$ 119.4	1070 $\pm$ 89.4	1152 $\pm$ 47.61	NS
Egg production (No. of eggs/day/group)	6.467 $\pm$ 1.907	6.267 $\pm$ 0.944	8.633 $\pm$ 0.890	*
Body Weight (Kg)	1.52 $\pm$ 0.007	1.53 $\pm$ 0.022	1.52 $\pm$ 0.036	NS

\*indicates level of significance at 5% level, NS indicates non-significance

### Effects of *Spirulina platensis* on hematological parameters

Total erythrocyte count, Hemoglobin concentration and Packed Cell volume are presented in Table 2. The highest TEC was recorded in group B (2.96 million/ $\mu$ L) followed by group A (2.86 million/ $\mu$ L) and group C (2.75 million/ $\mu$ L). At the same time in case of hemoglobin determination it was recorded that group B showed the highest value (8.03 gm %) followed by group A (7.76 gm%) and group C (7.17 gm%). Similarly PCV values were found highest in group B (31.33 %) followed by group A (29.67%) and group C (27%).

**Table 2.** Effects of *Spirulina platensis* on hematology in layers

Hematological Parameters	Mean $\pm$ SD			Level of Significance
	Group C (Control)	Group A (Spirulina 2gm)	Group B (Spirulina 4gm)	
TEC (million/ $\mu$ L)	2.75 $\pm$ 0.19	2.86 $\pm$ 0.07	2.96 $\pm$ 0.07	*
Hb (gm)	7.17 $\pm$ 0.11	7.76 $\pm$ 0.05	8.03 $\pm$ 0.07	*
PCV (%)	27 $\pm$ 0.74	29.67 $\pm$ 0.80	31.33 $\pm$ 0.92	*

\*indicates level of significance at 5% level, NS indicates non-significance

Treatment with *Spirulina platensis* causes improvement of hemoglobin (Hb), total erythrocyte count (TEC) and pack cell volume (PCV) regulation in group B and group A compared to the control group. These improvements caused by phycocyanine of *Spirulina platensis* (one of the active component in *Spirulina platensis*) which able to stimulate production of erythropoietin hormone that stimulates stem cells in the bone marrow to increase production of red blood cells (Ohlsson and Aher, 2006). These results also agreed with (Elmalawany *et al.*, 2014) who reported that, oral administration of *Spirulina platensis* with dose (100 mg/kg B.W. for 2 week) alone to the rat's increase RBCs count, Hb concentration and PCV%. Also (Pankaj and Varma, 2013) who found that oral administration of *Spirulina platensis* with dose (15 mg/kg B.W. for 21 days can improve the RBCs count, Hb concentration and PCV%. In contrast (Anitha *et al.*, 2006) observed that RBCs count, Hb concentration, PCV% were insignificantly changes in rats which treated with *Spirulina platensis* at dose (5 mg/kg B.W.) for 42 days.

### Effects of *Spirulina platensis* on lipid profile

The effects of *Spirulina* supplementation with ration on lipid profile (TC, TG, HDL, and LDL) are shown in Table 3. The lowest values are found in group A followed by group B and C in case of the parameters of TC, TG and LDL, which is found statistically significant (p value <0.05) on the other hand the HDL value increased significantly (p value <0.05) in group B comparing with Control group.

**Table 3.** Effects *Spirulina platensis* on lipid profile in layers

Lipid Profile	Mean $\pm$ SD			Level of significance
	Group C (Control)	Group A ( <i>Spirulina</i> 2gm)	Group B ( <i>Spirulina</i> 4gm)	
TC (gm/dl)	188.01 $\pm$ 3.02	177.51 $\pm$ 1.93	173.51 $\pm$ 3.14	*
TG (gm/dl)	255.91 $\pm$ 0.81	244.73 $\pm$ 1.27	240.17 $\pm$ 1.49	*
HDL (gm/dl)	47.42 $\pm$ 0.42	49.52 $\pm$ 0.57	51.50 $\pm$ 0.94	*
LDL (gm/dl)	95.40 $\pm$ 0.53	85.09 $\pm$ 0.71	80.36 $\pm$ 1.58	*

\*indicates level of significance at 5% level, NS indicates non-significance

In the present study, our data revealed significant reductions in total cholesterol, triglyceride and low density lipoprotein in Group B and Group A respectively compared to the group C as the level of dietary *Spirulina* was increased. And on the other side HDL level found significantly higher in group B and group A than group C. This is in consistent with previous finding by (Dogan *et al.*, 2016) who reported that HDL cholesterol concentration increased with the increased supplementation of *Spirulina platensis*. *Spirulina platensis* supplementation also decreased plasma total cholesterol and triglyceride levels between groups. In a study by (Hosseini-Vashan *et al.*, 2012) decreased LDL cholesterol was found by feeding them with a phytochemical compound.

Marley *et al.* (2012), by evaluating the effects of *Spirulina platensis* on local laying hens, observed that plasma cholesterol was significantly decreased in birds fed with the *Spirulina*- containing diets as compared to the control. Hypolipidemic effect of *Spirulina* has been reported to be due to the C-phycocyanin which inhibits the pancreatic lipase activity in a dose- dependent manner (Deng *et al.*, 2010). (Torres-Durán *et al.*, 1999) observed that *Spirulina maxima* were able to prevent the changes induced by carbon tetrachloride in liver lipids in rats. The presence of antioxidant compounds like phycocyanin and phenolic compounds and poly-unsaturated fatty acids in the spirulina can be the cause of the properties of *Spirulina* on the decrease of serum lipids levels. According to Nagaoka *et al.* (2005), both *Spirulina platensis* concentrates and phycocyanin, a protein pigment extracted of spirulina caused hypocholesterolemic activity in rats.

## CONCLUSIONS

*Spirulina* is a microscopic blue-green algae and it is considered as one of the richest sources of organic nutrients that are making it a good nutritional supplement for human and animal feed worldwide. From the current experimental data, indicated that spirulina has improved egg production, as well as improved the hematological parameter and lipid profile of layer birds.

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## CONFLICT OF INTEREST

Authors have no conflicts of interest to declare.

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