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Effects of Dietary Supplementation with *Pleurotus Ostreatus* on Biochemical, Lipid profile, and Antioxidant parameters of Broiler Chickens

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***Abstract*—** Oyster mushroom (*Pleurotus ostreatus*) contains bioactive components such as polysaccharides, beta-glucans and phenolic compounds; it is gaining popularity as a natural alternative to antimicrobial growth promoters in poultry production. These substances possess antioxidant, antimicrobial, and immunomodulatory properties that may improve the health and productivity of broiler chickens. The purpose of this study was to assess how supplementing with Pleurotus ostreatus affected liver function, antioxidant status, lipid profile, and biochemical markers. Under usual settings, two groups of broiler chickens were randomly assigned: a treatment group that received 2% Pleurotus ostreatus supplementation for six weeks, and a control group that received a basal diet. Blood samples were taken for serum analysis at the conclusion of the experiment. An independent t-test with a statistical significance level of $P < 0.05$ was used to analyze the data, which are presented as mean ± standard deviation. Compared to the control and treatment groups, the treatment group showed lower levels of glucose, cholesterol, triglycerides, very low-density lipoprotein (VLDL), alanine aminotransferase (ALT), and aspartate aminotransferase (AST). A significant decrease in triglycerides, VLDL, and AST was observed. While glutathione peroxidase (GSH-Px) levels decreased only slightly, albumin, globulin, and catalase levels increased slightly. These results suggest that oyster mushroom (Pleurotus ostreatus) may improve liver function and lipid metabolism in broiler chickens.

***Keywords* —** *Pleurotus Ostreatus*, Very low-density lipoproteinc, glutathione peroxidase, Triglycerides, Alanine Aminotransferase, Aminotransferase.

INTRODUCTION

The poultry sector is one of the fastest-growing sectors in global animal production and a vital source of inexpensive and nutritious animal protein to meet the growing needs of the population (1-2). Broiler chickens are of particular importance due to their rapid growth, feed efficiency, and low production costs. In traditional production systems, it has been impossible to overcome other factors, such as harmful microorganisms, environmental stressors, and malnutrition, which birds experience throughout their lives in intensive production systems (3-4). These factors limit their growth, feed efficiency, immunity, and health. Therefore, improving the growth and health of broiler chickens remains a key objective for poultry farmers and researchers worldwide.

For many years, antimicrobial growth promoters (AGPs) have been added to broiler chicken diets to increase weight, improve feed conversion efficiency, and enhance resistance to infectious agents (5-6). Despite their benefits, the long-term overuse and irresponsible use of antibiotics has led to the emergence of antimicrobial resistance and the accumulation of potentially harmful residues in poultry products, posing a public health concern (7-8). These concerns have resulted in the introduction of strict regulations and bans on the use of AGPs in many countries, thus encouraging the study of other natural feed additives that are potentially effective for maintaining the health of poultry's gut and stimulate the immune system and growth performance without compromising the safety of the product (9-10).

Due to their richness in bioactive compounds, such as polysaccharides, beta-glucans, phenolic compounds, vitamins, and minerals with antioxidant, antimicrobial, anti-inflammatory, and immunomodulatory properties, medicinal mushrooms have garnered increasing attention as natural feed additives (7-11). These compounds have been shown to improve intestinal structure (4), enhance

immune function (1), support glucose-producing gut bacteria, and help increase feed intake in chickens, particularly growing broiler chickens. Furthermore, through humoral and cellular immune responses, polysaccharides extracted from fungi, such as beta-glucans, promote resistance against infection (7-9).

Oyster mushroom (*Pleurotus ostreatus*) is an edible mushroom with nutritional value and bioactives properties, which has potential applications in poultry feed supplement (12). *Pleurotus ostreatus* is rich in proteins, essential amino acids, dietary fibre, vitamins, minerals and bioactive compounds such as lectins, β-glucans and phenolic compounds, all of which have been found to possess antimicrobial, antioxidant and immunostimulatory properties (13). The supplementation of broiler diets with Pleurotus ostreatus or its derivatives has been associated with better growth performance, feed efficiency, immune response and reduction in pathogen bacteria load within the gut (14-15).

The digestive system plays a pivotal role in immune defense, maintaining microbial balance, and food absorption and digestion in broiler chickens (1-16). High productivity and disease resistance depend on the integrity of the gut, balanced microbiota and optimum gut morphology. It has been demonstrated that the bioactive substances found in oyster mushrooms, including β-glucans and polysaccharides, can alter the gut microbiota by boosting the populations of helpful bacteria like Lactobacillus spp. and decreasing harmful germs like Salmonella spp. and Escherichia coli. (7-14).

MATERIALS AND MTHODS

Design of Experiments

Group 1 and Group 2 are two experimental groups of equal number of broiler chickens. The chicks were split into two groups, each consisting of 15 chicks, in a random manner. Standard environmental and management settings were used for the experiment. In addition to a basic diet, Group 1 (control group) was not given *Pleurotus ostreatus*. The second treatment (Group 2) was given *Pleurotus ostreatus* along with the basic diet. A feeding trial was run for a fixed period of time (six weeks).

Dietary Supplementation

A specified concentration of powdered *Pleurotus ostreatus* (2%) was added to group 2 experimental meal. To guarantee even distribution, the supplement was fully combined with the basal feed.

Sample Collection

At the conclusion of the trial, wing vein punctures were used to draw blood from randomly chosen birds in each group. To extract serum, the samples were put in plain tubes, allowed to coagulate, and then centrifuged for 10 to 15 minutes at 3000 rpm. Prior to biochemical examination, the serum samples were kept at -20°C.

Biochemical Analysis

Serum samples were analyzed to determine the following parameters

Table 1. Physiological and Biochemical parameters evaluated in the study.

General Parameters	Lipid Profile	Liver Enzymes	Antioxidant Parameters
Glucose	Total Cholesterol	Alanine Aminotransferase (ALT)	Glutathione Peroxidase (GSH-Px)
Albumin	Triglycerides (TG)	Aspartate Aminotransferase (AST)	Catalase
Globulin	Very Low-Density Lipoprotein (VLDL)		

STATISTICAL ANALYSIS

Mean ± standard deviation (SD) was used to express the data. The relevant software (such as SPSS) was used to conduct statistical analysis. An independent samples t-test was used to examine group differences. A statistically significant value was defined as $P < 0.05$.

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RESULT AND DISCUSSION

Table 2. Comparison of Biochemical Parameters Between Treatment Group and Controls Group (Mean ± SD).

Parameters	Group 1 (Control group)	Group2 (Treatment group)
Glucose mg/dL	162.45 ± 50.31	104.88 ± 45.06
Albumin g/dL	4.23 ± 0.63	4.26 ± 0.35
Globulin g/dL	3.05 ± 0.67	3.16 ± 0.55
Very Low-Density Lipoprotein (VLDL) mg/dL	20.86 ± 1.99	15.66 ± 3.34
Cholesterol mg/dL	195.80 ± 70.87	174.85 ± 84.31
Triglyceride mg/dL	63.67 ± 12.69	35.05 ± 5.75
Glutathione Peroxidase (GSH-Px) U/L	1.52 ± 0.37	1.21 ± 0.14
Catalase U/L	15.67 ± 6.00	15.82 ± 3.08
Alanine Aminotransferase (ALT) U/L	19.19 ± 1.89	15.23 ± 3.75
Aspartate Aminotransferase (AST) U/L	32.70 ± 6.62	21.59 ± 5.22

Glucose

The results in table 2 show that the glucose level of the control group (162.45 ± 50.31 mg/dL) was nonsignificantly (P value > 0.15) higher than that of the treatment group (104.88 ± 45.06 mg/dL). However, there was a noticeable decrease in the second group. This decrease when compared with the control group

corroborates the physiological trend towards hypoglycaemia suggested by the mushroom supplementation, although it was not statistically significant. This may be attributed to the presence of beta-glucans, polysaccharides and phenolic compounds in oyster mushrooms (*Pleurotus ostreatus*), which help increase insulin sensitivity and decrease the absorption of glucose in the intestine (17).

Albumin and Globulin

The results in table 2 show that the albumin and globulin levels of the control group (4.23 ± 0.63 and 3.05 ± 0.67 g/dL) were nonsignificantly (P value > 0.05) lower than those of the chicken food containing oyster mushrooms (*Pleurotus ostreatus*) group (4.26 ± 0.35 and 3.16 ± 0.55 g/dL), respectively. However, the albumin level of the second group was higher than that of the first group. albumin and globulin concentrations in broiler chickens fed oyster mushrooms showed a slight, but not statistically significant, increase consistent with the hypothesis that increased amino acid intake may improve protein metabolism and immune response. While globulin indicates immune system efficiency, albumin is a reliable indicator of liver protein synthesis function and nutritional health. The nutritional quality of the bioactive compounds in oyster mushrooms, which include important amino acids, vitamins, antioxidants, and polysaccharides that promote liver function and protein synthesis, may be responsible for the improved performance of the fed chickens. A previous study consisted of mushroom supplementation enhanced poultry physiological performance and protein utilization without significant changes in serum proteins under non-stressful conditions (18-19).

Lipid Profile

Table 2 shows that the triglycerides and very low-density lipoprotein (VLDL) levels were substantially higher (P value < 0.05) in the control group (63.67 ± 12.69 and 20.86 ± 1.99 mg/dL) than in the chicken food with oyster mushrooms (*Pleurotus ostreatus*) group (35.05 ± 5.75 and 15.66 ± 3.34 mg/dL) respectively, but the cholesterol level of the control group (195.80 ± 70.87 mg/dL) was not significantly (P value > 0.72) higher than that of the chicken food containing oyster mushrooms (*Pleurotus ostreatus*) group (174.85 ± 84.31 mg/dL). However, there was a noticeable decrease in the second group. The outcomes of lipid profile showed the oyster mushroom supplementation was more effective. The VLDL and triglyceride levels slowly decreased, suggesting that the *Pleurotus ostreatus* group had substantial hypolipidemic effects. Triglycerides are the major lipid transporters and storage molecules in poultry and any reduction of the triglyceride level could be considered as a sign of better lipid consumption or lower hepatic lipogenesis. The decrease in VLDL actually reflects a decrease in the formation and release of triglyceride-rich lipoproteins by the liver. These benefits can be attributed to ergosterol, dietary fibre, polyphenols, and β-glucans found in oyster mushrooms that play a major role in regulating lipid metabolism and cholesterol production. It has previously been reported that *Pleurotus ostreatus* mushroom prevents the decrease in circulating lipoproteins and hepatic lipid production (20). These results agree with other previously reported study results where oyster mushrooms improved lipid metabolizing and exhibited a hypocholesterolemic effect in broiler chickens (13).

Antioxidant Parameters

According to the results in table 2, the glutathione peroxidase (GSH-Px) and catalase levels of the control group (1.52 ± 0.37 and 15.67 ± 6.00 U/L) was nonsignificantly (P value > 0.18) higher than that of the chicken food containing oyster mushrooms (*Pleurotus ostreatus*) group (1.21 ± 0.14 and 15.82 ± 3.08 U/L) respectively. the present study revealed that catalase and glutathione peroxidase (GSH-PX) were not significantly different among broilers fed oyster mushrooms. The result does not necessarily mean that there is a decrease in antioxidant defense mechanisms, but rather a decrease in oxidative stress. *Pleurotus ostreatus* tissues contain high amounts of hydrophilic phenolics, flavonoids, and β-glucans, all of which have significant antioxidant ability. These compounds directly scavenge ROS, thus reducing the oxidative damage. This can reduce the size of the oxidant pool and, importantly, the need for endogenous antioxidant enzymes in these situations. In addition, dietary antioxidants have been suggested to help to regulate the redox balance in broiler chickens without changing their physiological status, and thus could further decrease endogenous antioxidant enzyme production, noted pointed. This is also indicated by the lack of change in catalase activity in the treatment and control groups, which suggests a normal antioxidant balance (21).

Liver Enzymes

The results in table 2 show that the aspartate aminotransferase (AST) level of the chicken food containing oyster mushrooms (*Pleurotus ostreatus*) group (21.59 ± 5.22 U/L) was substantially lower (P value < 0.03) than that of the control group (32.70 ± 6.62 U/L), but the alanine aminotransferase (ALT) level in the control group (19.19 ± 1.89 U/L) was nonsignificantly (P value > 0.14) higher than that of the chicken food containing oyster mushrooms (*Pleurotus ostreatus*) group (15.23 ± 3.75 U/L). However, there was a noticeable decrease in the catalase level in the second. Liver enzyme results also back up hepatoprotective effects of supplemental oyster mushrooms. Treated group AST levels were significantly reduced compared to the control group while no significant change in ALTs was seen. Lower elevated ALT and AST activities in broilers fed mushrooms indicated a protective effect to the liver which was suggested by decrease in liver stress and better liver integrity. The hepatoprotective effect of *Pleurotus ostreatus* may be attributed to its high content of phenolic compounds, flavonoids, Ergothionine and β-

glucans, all possessing potent anti-inflammatory and antioxidant activity, and protecting hepatocytes from oxidative damage and lipid peroxidation. Studies have demonstrated that dietary mushrooms exert hepatoprotective effects, leading to a reduction in serum ALT levels in both rodent and chicken models (22-23). According to the findings from this research, 2% supplementation with mushrooms *Pleurotus ostreatus* in broiler chicken model has a positive effect on metabolic health, lipid metabolism and antioxidant status.

CONCLUSION

Pleurotus ostreatus supplementation improved some of the physiological and metabolic parameters of broiler chickens. Modest increase in protein and antioxidant markers also reported, while marked reduction in triglycerides, VLDL and AST are indicative of good lipid metabolism and liver function. Even though some of the changes were not significant, the overall trend is positive. *Pleurotus ostreatus* thus has potential for improving productivity and health of production systems for chickens as a natural feed additive**.**

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N/A

Conflict of Interest

The author declare no conflict of interest.

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