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Efficiency of adding potato (Solanum Tuberosum) peel powder to feed in enhancing broiler physiological characteristics and productivity

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The purpose of this study was to determine how adding varying amounts of potato peel powder to broiler diet would affect the animals' physiological and productive performance. The study used 240 Ross-308 broiler chicks that were one day old, unsexed, and kept together for seven days. After that, the chicks were divided into four treatments at random, with three duplicates of each treatment, each containing twenty chicks. They grew up on a bed of sawdust on the floor of a confined hallway. The treatments were: T1 (control, no feed addition), potato peel powder was added at a rate of 20% (T2), 30% (T3) and 40% (T4). The average total live body weight of all birds increased significantly when potato peel powder was added to their feed. Additionally, when compared to the control treatment, the cumulative weight of all birds with potato peel powder increased, and their feed consumption rate and feed conversion ratio significantly improved. The levels of glucose, cholesterol, triglycerides, and low-density lipoproteins (LDL) significantly decreased in all treatments involving the addition of potato peel powder, while the levels of high-density lipoproteins (HDL), globulin, albumin, and total protein significantly increased. The amount of red and white blood cells, hemoglobin concentration and hemoglobin were all significantly higher in the blood tests of birds receiving potato peel powder. We conclude that adding potato peel powder at varying rates increased some physiological and productive parameters of broiler chickens.

Keywords: Potato peel powder, feed additives in physiological traits, broiler

INTRODUCTION

One of the food businesses with the quickest rate of growth is poultry production, which is often defined by the production of meat, eggs, and their byproducts (Ren et al., 2020). Meat and eggs are examples of animal products that are essential to human nutrition, given the increasing interest of consumers in how to improve the quality of food with high levels of protein and low energy and the direct relationship with nutrition and health. This has led to interest in functional foods, which are defined as food in a natural form and not in the form of capsules or pills, which in addition to the nutritional cycle has a functional effect on the work of one or more body organs, either improving physiological functions or reducing the risk of disease (Ranilla et al., 2010; Adebayoet, 2010; Al-Jebory et al., 2023 c-e). Therefore, nutritional additives have entered poultry feed such as enzymes, organic acids, yeasts, bio-enhancers and medicinal plants or their extracts and oils, because they have an effective effect in increasing digestion efficiency and improving growth (Al-Mashhadani et al., 2014). Potatoes are a phytochemical nutrient and are tubers that are widely used for human consumption. They include a variety of physiologically active substances, including phenolic compounds, minerals, vitamins, amino acids, dietary fiber, and starch (Calliope et al., 2018). Both the peel and the flesh of potatoes contain phenolic chemicals, however the peel has been shown to have a larger concentration (Ezekiel et al., 2013). Potato peel has drawn a lot of interest as a natural antioxidant because of its higher phenolic content, which has been shown to be 10 times higher than the quantities in the tuber, which make up around half of its contents. The antioxidant

potential of potato peel was then extensively utilized in food analysis (Javed et al., 2019). Phenolic acids and flavonoids, such as flavonols and anthocyanins (Rodríguez-Martínez et al., 2021), are the phenolic compounds present in potatoes. They have been proposed to have anti-inflammatory, anti-cancer, and antidiabetic properties (Khoo et al., 2017; Shittu et al., 2021). In addition, phenols derived from purple potatoes are a promising anti-inflammatory agent (Zhang et al., 2019). A recent study confirmed that potato peels contain many substances with high nutritional value, including minerals, proteins, vitamins and amino acids, and can be used as an alternative to other ingredients, especially corn, in animal feed (OCP and Dumkenechukwu, 2022). Therefore, this study aimed to determine the effect of adding different concentrations of potato peel powder to broiler feed on improving productive and physiological performance.

MATERIALS AND METHODS

240 unsexed Ross-308 broiler chicks, one day old, weighing an average of 42 g, were used in this investigation between January 3, 2024, and April 4, 2024. The effectiveness of adding three different amounts of potato powder to the feed was examined in this study in order to examine how it affected the physiological traits and productive traits of the broiler chicks. A starter feed was given to the chicks when they were 1–21 days old, and a final diet was given when they were 22–35 days old. The starting and end feeds were utilized to feed the chicks during the experiment period. After being gathered, potato peels were thoroughly cleaned with water to remove any remaining dust or dirt, and they were then allowed to air dry (Kpanja et al., 2020). A grinder was used to grind them into a fine powder, which was then kept at room temperature in plastic bags for subsequent use. Two phases were used to handle the chicks: 1) The pretreatment phase: The time frame from one day to seven days without the use of potato powder to help the chicks become used to the hall environment. Before and after treatment, a continuous lighting system was used to freely supply food and drink. 2) The course of treatment lasted from the age of 8 days to the age of 35. The chicks were grown in a prepared hall separated into cages with dimensions of each cage 1.5 x 1 m according to the floor raising system. Twelve cages containing four treatments were randomly assigned to the chicks; each treatment had three replicates, with twenty birds per replicate. On the seventh day, potato peel powder was introduced in the manner described below:

Basic feed was used in the first treatment (control), which was devoid of addition;

In the second, third, and fourth treatments, dry potato peel powder was added at concentrations of 20, 30, and 40%, respectively.

Researchers looked at how the groups were affected by taking certain measurements:

Features of production: These included live body weight, weight gain, feed conversion ratio, and feed consumption rate, all of which were assessed (Naji , 1989) at the age of 35 days (the end of the experiment).

Physiological traits: These included blood serum levels of glucose, total protein, albumin, globulin, low-density lipoproteins (LDL), high-density lipoproteins (HDL), cholesterol, and triglycerides. They were assessed at the conclusion of the experiment at the age of 35 days. Blood was drawn obliquely from the birds' brachial veins in anticoagulant-free tubes, then centrifuged at 3000 rpm to separate the blood plasma. The serum was then transferred to special sealed test tubes, which were then stored in a freezer at -20°C until the aforementioned characteristics were measured. The blood plasma's hemoglobin and red and white blood cell counts were computed. A kit from the German manufacturer Roche was used to assess the glucose levels using the Coles (1986) method. The concentration of cholesterol and high-density lipoproteins was determined using a kit from the German Roche firm according to the method of Franey and Elias (1969). Regarding low-density lipoproteins, the Grundy et al. (2004) technique was used to estimate them. The pre-made analysis kit (Kit) was used to measure the amount of triglycerides in the blood serum. A spectrophotometer

was then used to read the samples at a wavelength of 546 nanometers in accordance with the procedures described by Trinderner (1969) and Fossati and Prencipe (1982). According to Tietz et al. (1999), a kit from the French Biolabo firm was used to quantify the concentration of total protein. The following formula was used to determine the amount of globulin in the blood serum using Bishop et al. (2000)'s method: Globulin (g/100 ml serum) is equal to albumin minus total protein.

Regarding blood measurements, the Archer (1965) method was used to calculate the hemoglobin concentration, the Varley et al. (1980) method was used to estimate the hemoglobin concentration, and Natt and Herrick (1952) method was used to estimate the number of red blood cells. The effect of treatments on the features was investigated using a completely randomized design. Duncan's multinomial test (1955) was used to examine the significant differences between all averages, and the data was analyzed using the pre-made statistical software SAS (2012).

RESULTS AND DISCUSSION

Production traits

The average live body weight, total weight increase, total feed consumption, and cumulative feed conversion factor varied significantly ($P \leq 0.05$) among the experimental treatments (Table 1). The live body weight and total weight gain of all birds in the dried potato powder supplementation treatments were significantly higher ($P \leq 0.05$) than those in the control treatment at the conclusion of the fifth week of the trial. The fourth treatment with a concentration of 40% gave the highest average live weight of (2118 g) and the highest weight gain of (2044 g). The significant increase in the average live body weight and total weight gain of birds with the addition of potato peels with content of phenolic compound that has a high ability to act as an antioxidant in the diet (Althawab et al., 2019). This phytochemical improved growth performance in addition to the role of the components of purple sweet potato extract in improving the protein digestion coefficient and increasing the amount of protein deposited in broiler meat to reflect the positive role of potato peel powder in improving growth and muscle building and thus improving the weight gain rates of broilers. In addition, the active substances anthocyanin and flavonoids found in dried potato peels improve the health of birds, which led to an increase in protein intake as a substrate for protein deposition in the meat (Saputra et al., 2016).

Regarding the cumulative feed consumption, it was observed that the birds of the fourth treatment recorded 3219 g of feed/bird, which was significantly lower ($P \leq 0.05$) than the birds of the first treatment, which recorded 3447 g/bird (Table 1). The birds of the third and second treatments then recorded 3340 and 3401 g feed/bird, respectively. The same table 1 results showed that, in contrast to the first treatment, which recorded 1.77 g feed/g weight gain, the birds in the second, third, and fourth treatments—which added potato peel powder—all had the best cumulative feed conversion factors, reaching 1.71, 1.66, and 1.58 g feed/g weight gain, respectively. This is due to the positive effect of the content of potato peels of active chemical compounds that are digestive stimulants, as they stimulate the digestive tract to secrete digestive enzymes such as lipase and amylase, which play an important role in the digestion of fats and sugars (Arapoglou et al., 2009; Al-Jebory et al, 2023 a-b).

In addition, the antimicrobial activity of potato peel extracts leads to improved body immunity and thus increased resistance to diseases and improved performance in broiler chickens (Juneja et al., 2018). The improvement in the feed conversion rate may be due to active compounds content in potato peels such as phenolic compounds and flavonoids (Chang, 2019), which act as antioxidants and bacterial inhibitors (Sharma et al., 2014) and antivirals (Pezeshk et al., 2015; Silva-Beltrán et al., 2017). These properties in turn do not only contribute to increase the productivity of birds, but also to improve the general health of birds and thus improve feed conversion rates. It has been proven that purple sweet potato extract has beneficial effects on animals and humans in general

through its antioxidant role in reducing the level of Malondialdehyde compound as well as its role in improving blood sugar control (Jawi et al., 2015; Mahadita et al., 2016).

Physiological traits

It is clear from the results of Table 2, which includes the effect of adding dried potato powder to broiler feed, that the number of red and white blood cells increased significantly (P≤0.05), as the third and fourth treatments showed a significant superiority (P≤0.05) in the number of red and white blood cells in the blood of birds compared to the rest of the experimental treatments, while no significant differences appeared between the first and second treatments in both characteristics. The blood of birds of all addition treatments recorded a significant increase (P≤0.05) in the concentration of hemoglobin and hemoglobin concentration compared to the first treatment. The reason for the improvement of some blood parameters of broiler birds may be due to the addition of potato peel powder to the bird feed, as these materials contain biologically active compounds, which are flavonoids and phenolic acids, including anthocyanins and flavonols (Deusse et al., 2012). If the relationship between polyphenol intake and the reduced incidence of some diseases is observed in many studies (Akyol et al., 2016). However, the positive effects cannot be attributed solely to their antioxidant properties and the health benefits of polyphenols can be attributed to some complex non-antioxidant activities that cannot be linked to free radical inhibition (Andre et al., 2014).

Blood parameters serve as indicators of the physiological status of birds (Mohammed et al., 2015). The antioxidant potential of potato peel extract as a defense against oxidative stress induced by red blood cells was examined in vitro with observation of morphological and structural differences in the cell membrane (Javed et al., 2019). The blood serum of birds in all supplementation treatments showed a significant increase in high-density lipoproteins (HDL), total protein, albumin, and globin, and a significant decrease (P≤0.05) in the concentrations of glucose, cholesterol, triglycerides, and low-density lipoproteins (LDL), according to Tables 3 and 4. The decrease in the concentration of glucose, cholesterol, triglycerides and low-density lipoproteins in the blood serum of birds in the potato peel powder supplementation treatments may be attributed to a decrease in cholesterol absorption in the digestive system or its synthesis or both or to the role played by phenolic compounds as antioxidants and free radical suppressors (Arun et al., 2015). In addition, anthocyanins indirectly reduced the levels of lipoprotein B and apoprotein C-III, which are major carriers of triglycerides, which led to a decrease in their content in blood plasma. Anthocyanins facilitated the excretion of cholesterol through the feces (Shah and Shah, 2018; Nasoetion et al, 2019). The significant increase in the levels of HDL with a beneficial effect and the decrease in the levels of LDL with a harmful effect in all addition treatments, which is considered a good indicator of the health and vitality of the birds, which was positively reflected in the performance of the birds. The increase in total protein in the serum of birds (Table 4) may be due to the high weights of birds, as there is a positive correlation between live body weight and total serum protein (Krupakaran, 2013). Arora and Samples (2011) also mentioned that there is a positive relationship between live body weight and the improvement of physiological characteristics of birds, as heavier birds had higher plasma proteins when compared to lighter birds, and that following a diet containing polyphenols reduces the numbers of Clostridium and bacteria, as reducing the numbers of these pathogenic bacteria in the digestive system can lead to improving the health of the digestive system as well as improving protein digestion (Viveros et al., 2011; Al-Jebory, 2021 a-b).

CONCLUSION

We conclude from the results of the study that adding potato peel powder at different concentrations improved some productive and some physiological characteristics of broiler chickens compared to the control treatment that was free of the addition.

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