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Effect of supplementing humic substance on carcass characteristics in broilers

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Abstract
The effect of humic substance supplementation on broiler carcass character measures was investigated in this study. One hundred twenty-day-old broiler chicks were split into four groups: three experimental groups were fed diets containing 0.02% humic substance (T_2), 0.04% humic substance (T_3), and 0.02% bacitracin methylene disalicylate (T_4), while the control group (T_1) was fed a standard diet prepared in accordance with the Bureau of Indian Standards (2007). There was a significant difference ($p \leq 0.05$) in the dressing percentage of the carcass in the groups fed 0.02 percent BMD and 0.04 percent humic substance compared to the control group. However, there was no significant difference ($p > 0.05$) in the drumstick yield, breast yield, thigh yield, abdominal fat percentage, or the relative weight of the liver, gizzard, heart, and proventriculus in any of the groups.

Keywords: Humic substance, carcass characteristics, antibiotic growth promoter, broilers

1. Introduction
The introduction of new strains, disease prevention, and scientific management techniques have all contributed to the poultry industry's notable expansion in recent years. This expansion has increased farmers' income by significantly adding to the world's supply of high-quality proteins, such as meat and eggs. Alongside this achievement, though, there is a questionable practice of subtherapeutic antibiotic use in chicken production. Historically, this method sought to improve chicken health and development by reducing harmful germs, adjusting immunology, and reducing inflammation (Niewold, 2007) [8] Scientific data highlights the alarming fact that the use of antibiotics without due diligence is causing bacterial resistance to evolve (Apata, 2009) [2] These resistant bacteria have been found in a variety of habitats and may pose a health risk to humans (Zhang *et al*., 2020) [14]. The European Union introduced a comprehensive ban on the use of growth-promoting antibiotics in animal production in 2006 in response to the growing concern over antibiotic resistance. The United States then acknowledged the potential risks to public health associated with antibiotic resistance in 2017 (Salim *et al*., 2018) [11]. This dual scenario highlights the need for a careful balance between expansion aspirations and public health concerns by posing significant questions regarding the sustainability and long-term effects of antibiotic usage in the chicken business.
An alternative that is becoming more and more popular in poultry nutrition is adding humic materials to the diets of broiler chickens. Humic compounds are derived from the breakdown of organic waste and have unique qualities that can improve the digestion of nutrients, encourage development, and improve the general health of chickens. Humic substances are organic molecules with a high molecular weight and long molecular chains that are produced when organic matter breaks down. Humic substances, which make up the majority of soil organic matter, may be divided into three main fractions: fulvic acids (an alkali- and acid-soluble fraction), humin (an alkali- and acid-insoluble fraction), and humic acids (HA), an acid-insoluble fraction (Abd El-Hack, 2016) [1].
Humic compounds have a crucial role in poultry productivity and possess various vital properties, including water solubility, antimicrobial properties, proteins, and immune-stimulating chemicals. By elevating the numbers of advantageous bacteria, they can alter the intestinal microflora, as Schepetkin *et al.* (2003) [12] showed.

Furthermore, studies by Taklimi *et al*. (2012) [13] indicate that humic acids (HA) may affect the broiler's jejunum's villi height and crypt depth. Moreover, humic materials have been shown to have anti-inflammatory, adsorbent, antitoxic, and antibacterial qualities, protecting the gut mucosa. Humic compounds have a considerable adsorption capacity due to their varied structures and functional groups, which contribute to features including ion exchange, spectral, electrochemical, and colloidal properties.

In comparison to the control and 450 ppm groups, broilers given diets containing humic compounds exhibited greater carcass weights at 150 ppm and 300 ppm, according to Ozturk *et al*. (2012) [9]. In comparison to the 450 ppm group, the dressing percentage rose in the 150 ppm group. It's possible that the 450 ppm group's lower feed intake and metabolizable energy led to their increased thigh meat fat content compared to the control group. Dominguez *et al*. (2019) [4] found that broilers given antibiotics and humic substance extract had greater carcass yields than the control group. In comparison to the control group, Elnaggar *et al*. (2022) [5] observed that feeding humic substance raised dressing percentage and decreased abdominal fat in broiler chicks. All things considered, these investigations indicate that supplementing with humic substances has a good impact on carcass traits, maybe as a result of increased feed efficiency and decreased oxidative stress.

Koksal and Kucukersan (2012) [6] investigated the impact of humates supplementation on broiler diets and found no statistically significant differences (p>0.05) in the weights of heart, liver, and gizzard among treatment groups. Abd El-Hack (2016) [1] also reported no significant effects (p>0.05) of dietary humic acid supplementation on heart, liver, gizzard weights, and gut length in broiler chicks. Similarly, Pistova *et al*. (2016) [10] found no significant effect ($P \geq 0.05$) of humic acid supplementation on heart and liver weights, but observed a significantly ($p \leq 0.05$) greater weight of the gizzard in chickens fed a diet with 1% humic acid compared to the control group.

2. Materials and Methods

Venkateshwara Hatcheries Pvt. Ltd. provided 120 day-old commercial broiler chicks for this investigation, and Novel Links, Srigandada Kaval, Bengaluru provided the humic substance. The chicks were first evaluated on the basis of their weight upon acquisition, and then they were split into four experimental groups at random. There were three duplicates in per group, and each replicate included 10 chicks. Based on the guidelines provided by the Bureau of Indian Standards (BIS) in 2007, the basal diet (T_1) was created. For Treatment 2 (T_2), 0.02% humic material was added to the baseline diet. For Treatment 3 (T_3), 0.04% humic material was added to the baseline diet. Additionally, 0.02 percent antibiotic BMD (bacitracin methylene disalicylate) was added to the baseline diet for Treatment 4 (T_4).

Up to the age of six weeks, the chicks were kept under regular management procedures and grown in a deep litter system. The birds were vaccinated according to a standard vaccination schedule. Water and food were given to the animals whenever they needed them during the trial. The KVAFSU Institutional Animal Ethics Committee in Bidar, Karnataka, gave its approval to the study.

2.1 Carcass traits and visceral organ weights

2.1.1 Carcass traits

Two birds from each replication in both treatment groups were slaughtered at the end of the experiment to look at different aspects of the carcass. These included visceral organ weights (heart, liver, gizzard, and proventriculus), dressing %, drumstick yield, thigh yield, breast yield, and abdomen fat. The information pertaining to these attributes was meticulously documented and shown as grams percent (g/100 g), offering significant understanding into the general composition of the carcass and the development of its organs in response to the experimental treatments.

a) Dressing percentage

The birds were allowed only unrestricted access to drinking water during their 12-hour fast before to slaughter. The birds' live weight was then noted.

The jugular vein and carotid artery on one side of the neck were severed, enabling the birds to bleed for one to two minutes before they were mercifully put down for slaughter. The birds were then mechanically defeated in a rotating drum picker for around 30 to 60 seconds after being momentarily scorched at 54 °C in a dipping scalder for two minutes.

Cutting the legs at the hock joint and the head at the atlanto-occipital junction were part of the dressing procedure. The gastrointestinal system, separable fat, and edible and non-edible organs were removed from the carcass during the evisceration process, which involved cutting an incision in the abdomen.

The dressing percentage was calculated using the following formula:

$$\text{Dressing percentage (\%)} = \frac{\text{Eviscerated carcass weight (g)}}{\text{Live weight before slaughter (g)}} \times 100$$

And expressed as a percentage of the live body weight. This calculation provided insight into the efficiency of meat production in relation to the live weight of the birds.

b) Yield of Drumsticks

Weighing each slaughtered bird's drumstick section across all treatments allowed us to examine the effects of feeding humic acid and given as a percentage of the equivalent bird's live weight.

c) Yield of Thighs

To investigate the impact of feeding humic material, the thigh was separated at the thigh joint, weighed, and its weight was expressed as a percentage of the associated bird's live weight.

d) Yield of Breast

To evaluate the effect of feeding humic material, the breast was removed from the slaughtered bird and weighed. The results were reported as a percentage of the matching bird's live weight.

e) Abdominal fat percentage

Each bird's abdominal fat, including that around the gizzard, bursa, cloaca, and surrounding muscles, was retrieved, and the weight of that fat was represented as a percentage of the bird's live weight.

2.1.2 Relative visceral organ weights

Two birds from each replication in both treatment groups were slaughtered at the end of the experiment to determine the effect of feeding humic material on the weights of visceral organs, including the liver, gizzard, heart, and proventriculus. The information pertaining to these traits was meticulously documented and displayed as grams percent (g / 100 g).

a) Heart weight
Using the observed weights from each replication, the average weight of the heart—excluding the pericardium—was computed. The percentage of the average live body weight was then used to express this weight.

b) Liver weight
The recorded weight from each replication was taken into account to determine the average weight of the liver, excluding the gall bladder. The percentage of the average live body weight was then used to express this weight.

c) Gizzard weight
The recorded weights from each replication were used to calculate the mean weight of the gizzard, eliminating feed contents and the internal lining membrane. Following computation, the weight was represented as a percentage of the average live body weight.

d) Proventriculus weight
Using the weights acquired for each replication, the proventriculus's mean weight was calculated, excluding the feed contents and the interior lining membrane. Next, a percentage of the average live body weight was calculated using this computed weight.

3. Results
3.1 Carcass traits
The mean dressing percentages in groups T_1, T_2, T_3, and T_4 on the 42nd day of the trial were 64.32, 66.61, 74.88, and 74.23 percent, respectively. Compared to groups T_1 and T_2, the treatment groups T_3 and T_4 exhibited considerably ($P < 0.05$) higher dressing percentages. The average body weight did not change significantly ($P > 0.05$) between treatment groups T_3 and T_4, as well as T_1 and T_2.
On the 42nd day, the thigh yield (as a percentage of live weight) for groups T_1, T_2, T_3, and T_4 were, respectively, 15.58, 16.84, 17.92, and 18.47. According to ANOVA, there was no discernible variation in thigh yield across the treatment groups ($p>0.05$).
On the 42nd day, the breast yield (percentage of live weight) for groups T_1, T_2, T_3, and T_4 was 33.77, 34.39, 35.59, and 35.61, in that order. A non-significant ($p>0.05$) variation in breast yield was found across treatment groups by statistical analysis.
Drumstick yield (as a percentage of live weight) was 9.96, 9.99, 9.94, and 10 in groups T_1, T_2, T_3, and T_4. ANOVA showed that the drumstick yields of the various treatment groups did not differ in a way that was statistically significant ($p>0.05$).
At the conclusion of the trial, the percentages of abdominal fat in groups T_1, T_2, T_3, and T_4 were 1.29, 1.26, 1.23, and 1.24, respectively. An analysis using ANOVA showed that there was no significant difference ($p>0.05$) in the percentage of abdominal fat between the treatment groups.

3.2 Visceral organ weight
Among the various treatment groups, the heart weight (percentage of live weight) was 0.516 (T_1), 0.540 (T_2), 0.532 (T_3), and 0.536 (T_4). According to statistical analysis, there was no discernible variation in heart weight between any of the groups and the control group ($p>0.05$).
In the different treatment groups, the liver weight (as a percentage of live weight) was 1.691 (T_1), 1.718 (T_2), 1.731 (T_3), and 1.709 (T_4). There was no statistically significant difference ($p>0.05$) in liver weight between any of the groups and the control group.
In the various treatment groups, the Proventriculus weight (as a percentage of live weight) was 0.439 (T_1), 0.425 (T_2), 0.441 (T_3), and 0.448 (T_4). Regarding proventriculus weight, the groups did not differ significantly ($p>0.05$) from the control group.
In the treatment groups, the gizzard weight (as a percentage of live weight) was 1.569 (T_1), 1.585 (T_2), 1.516 (T_3), and 1.528 (T_4). In comparison to the control group, there was no statistically significant difference ($p>0.05$) seen in any of the groups.

4. Discussion
4.1 Effect of humic substance on carcass characteristics
There was significant difference ($p\leq0.05$) in dressing percentage and no significant difference ($p>0.05$) in breast yield, thigh yield, drumstick yield and abdominal fat percent of birds in the groups fed with humic substance compared to the control group at the end of the experiment (42nd day).
The current findings are consistent with the study by Marcincakova *et al*. (2015) [7] in which they supplemented humic substance in the feed and found that the humic substance supplemented group had a significantly higher dressing percentage compared to the control group ($P < 0.05$). Although the weights of breast and thigh muscles were slightly higher in the humic substance-supplemented groups, the differences were not significant ($p>0.05$).
In contrast Abd El-Hack. (2016) [1] concluded in the study of dietary humic acid supplementation on carcass characteristics of broiler chicks and his findings indicated that diets with varying levels of humic acid supplementation did not result in significant changes ($p>0.05$) in dressing weight percent.

4.2 Effect of humic substance on visceral organs
There was no significant difference ($p>0.05$) in relative weight of heart, liver, proventriculus and gizzard of birds in the groups fed with humic substance compared to the control group at the end of the experiment (42nd day).
The current findings are consistent with the study of Abd El-Hack. (2016) [1] who conducted a study to investigate the effects of dietary humic acid supplementation on relative visceral organs weight of broiler chicks. Their reported results showed that there were no significant impacts ($p>0.05$) attributed to humic acid supplementation on gizzard, liver and heart weights.
In contrast Pistova *et al*. (2016) [10] found that while the addition of humic acid to the diet did not lead to any significant difference in the weight of the heart and liver across groups, but, there was a significant ($p\leq0.05$) increase in the weight of the gizzard in chickens fed a diet supplemented with 1% humic acid compared to those in the control group.

5. Conclusion
The addition of 0.04% humic substance and 0.02% bacitracin methylene disalicylate (BMD) to the basal diet resulted in a significant improvement ($p\leq0.05$) in dressing percentage. However, there was no significant difference ($p>0.05$) observed in breast yield, thigh yield, drumstick yield, abdominal fat percentage and the relative weight of liver, gizzard, heart and proventriculus in humic substance and BMD fed groups compared to control at the end of the experiment (42nd day). The result of 0.04% humic substance and 0.02% BMD supplementation showed similar improvement in broilers birds.

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