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# Effects of Different Levels of Rice on Small Intestine of Broiler Chickens

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***Abstract*— Rice is a seed derived from the grass species Oryza sativa or Oryza glaberrima. This paper investigates the several facets of rice, including its nutritional worth, cultural relevance, methods of farming, and worldwide significance. Rice is a promising grain that is reasonably priced and may be effectively added to chicken rations. Because rice is more readily available than corn and has comparable protein and metabolizable energy levels. The current study aimed to see the effect of replacing corn with cheap rice and to see its effect on broiler chicken's small intestine by measurement intestine villi high, villi width, villi area, crypt depth and muscular thickness ratio A total of one hundred sixty (160) at one-day-old unsexed chicks of the Rose 308 breed were purchased from local hatchery. The birds were fed on basil diet for two-week (14 days), at day 15 of the experiment the bird was randomly divided into 4 groups each group contain forty (40) birds, and each group was subdivided into two groups, each group contain 20 birds, in a sector design. The control group (T) was fed on the basil diet, while the birds in group T1, T2, and T3 were fed 10%, 20%, and 30% of the rice were given by replacing corn in the food ration. The current study showed that there is a significant (P≤ 0.05) increase in the duodenum, jejunum and ilium villi length (mm). Villi width (mm) villi area (mm)2 crypt depth in the basil diet group as compeer with other groups. the current study concludes that as the amount of rice provided to broiler chickens increases leads to a decrease in the length, width, and crept depth of the villi.**

***Keywords* — Broiler, Rice, Villi Length, Villi Width, Crept Depth, Gut Health.**

## I. INTRODUCTION

THE primary source of protein in broiler feed is typically derived from plant-based ingredients, such as soybean meal, corn gluten meal, and canola meal. These ingredients are rich in essential amino acids, which are the building blocks of protein. Amino acids such as lysine, methionine, and threonine are particularly important in broiler diets as they are limiting amino acids, meaning their availability can affect overall protein synthesis (1).

The food or diet given to broiler chickens has a significant impact on their gut health. The gut plays a crucial role in digestion, nutrient absorption, and immune function, and maintaining a healthy gut is essential for the overall well-being and performance of broiler chickens (2).

Soybean meal and yellow corn are standard feed ingredients because of their high nutritional levels. It seems that the developing world's use of poultry products such as meat and eggs is rising. As a result, the cost of producing chicken would rise due to an increase in worldwide demand for the primary feedstuffs for poultry (3).

Rice stands out as a versatile and energy-dense option, offering potential benefits to broiler chickens when incorporated into their diets. The use of rice in chicken diets has grown in popularity. Being an excellent source of protein, energy, vitamins, and minerals, it has a lot of promise as a nutritional element (4)

Rice has a significant amount of protein including four different fractions such as prolamin, glutelin, globulin, and albumin with different solubility characteristics (5). These proteins exhibit a higher amino acid profile, so they are nutritionally important and possess several functional properties. Compared with many other cereal grains, rice protein is hypoallergic due to the absence of gluten (6).

Rice is considered a good source of energy for poultry, and it can contribute to the overall nutritional profile of the feed, Rice is highly digestible for poultry, providing a good source of carbohydrates, The digestibility of rice can positively influence the growth and performance of broiler chickens (7). Rice is not particularly high in fiber compared to some other grains; it does contain some dietary fiber. The presence of fiber can influence the gut environment and may have positive effects on the intestinal microflora by promoting the growth of beneficial bacteria (8). The impact on intestinal microflora can be indirect, as the overall diet composition influences the microbial balance in the gut. A well-balanced diet that includes rice along with other ingredients like proteins, vitamins, and minerals can contribute to a healthy gut microbiota (9).

## II. Materials and Methods

A total of one hundred sixty (160) at one-day-old unsexed chicks of the Rose 308 breed were purchased from local hatchery. The birds were fed on basil diet for two-week (14 days), at day 15 of the experiment the bird was randomly divided into 4 groups each group contain forty (40) birds, and each group was subdivided into two groups, each group contain 20 birds, in a sector design. The control group (T) was fed on the basil diet, while the birds in group T1, T2, and T3 were fed 10%, 20%, and 30% of the rice were given by replacing corn in the food ration as shown in table (1), After the end of the experiment, the animals were sacrificed, and intestinal samples were taken and preserved with 10% formalin. Histological sectioning was performed according to (10) and intestine samples were measured using a graduated lens for measuring villi length, villi width, crypt depth, muscular thickness.

### Statistical analysis

Statistical analysis was done by using spss in level 0.05.

**Table 1:** composition of the broiler chickens' diet (Kg per ton)

| Ingredients | control | 10% rice | 20% rice | 30% rice |
|---|---|---|---|---|
| **Yellow corn** | 53.2 | 43.2 | 36.2 | 26.2 |
| **Soya** | 31 | 31 | 31 | 31 |
| **Rice** | 0 | 10 | 20 | 30 |
| **Premix** | 2.5 | 2.5 | 2.5 | 2.5 |
| **Soya hulls** | 2.5 | 2.5 | 2.5 | 2.5 |
| **wheat** | 7.5 | 7.5 | 7.5 | 7.5 |
| **Lime** | 1.2 | 1.2 | 1.2 | 1.2 |
| **Oil** | 1.1 | 1.1 | 1.1 | 1.1 |
| **Antifungal** | 1 | 1 | 1 | 1 |
| **Enzyme** | 100 | 10 | 10 | 10 |

## III. Result & discussion

In the current study Duodenum Villi length show a significant ($P \leq 0.05$) increase in the control group as compeer with the other group .10 % rice & 20 % rice show no significant deference between them, while 30 % show a significant ($P \leq 0.05$) increase as compeer with the 20 % group. The Villi width shows a significant decrease in 10 % rice group as compeer with the other group. villi area show no significant deference between the control group and 20 % rice group, while there were a significant ($P \leq 0.05$) increase as compeer with the 10 % rice group and 30 % rice group, 10 % show a significant ($P \leq 0.05$) decrease as compeer with the other groups, CRYPT DEPTH show a significant increase in control group as compeer with the other groups , also the 10 % & 30 % show no significant as compeer with each other , while 20% group show a significant ($P \leq 0.05$) decrease as compeer with other groups . Muscular thickness shows a significant ($P \leq 0.05$) increase in the control group as compeer with the other groups. As shown in the Table (2).

**Table 2:** effect of basal diet, 10 %, 20% and 30 % rice on Duodenum Villi

| Groups | Duodenum Villi length (mm) | Villi width (mm) Mean ±S. D | Villi area (mm) $^2$ Mean ±S. D | CRYPT DEPTH | MUSCUAR THICKNESS |
|---|---|---|---|---|---|
| **Control** | 1,085.78 ±102.13 A | 95.91 ±7.9 A | 104145.3 ±140.13 A | 152.12 ± 12.6 A | 131.08 ± 14.2 A |
| **10%** | 963.703 ± 80.12 B | 69.23 ± 9.6 B | 66722.46 ±122.6 C | 143.72 ±13.7 B | 95.21 ± 7.4 B |
| **20%** | 948.16 ± 60.4 BC | 113.7 ±14.2 A | 107834.2 ±144.13 A | 116.20 ± 16.5 C | 94.53 ± 9.2 B |
| **30%** | 986.237 ± 8.74 B | 91.69 ±11.2 A | 90428.0 ±130.9 B | 149 ± 19.8 AB | 98.89 ± 8.4 B |

In the current study jejunum Villi length, width and villi area show a significant ($P \leq 0.05$) increase in the control group as compeer with the other group, also crypt depth sows a significant increase in the control group as compeer with the other group, on the other hand muscular thickness show a significant increase in the 30 % rice group as compeer with the control group as shown in the table (3).

**Table 3:** effect of basal diet, 10 %, 20% and 30 % rice on jejunum Villi

| Groups | Villi length (mm) | Villi width (m) Mean ±S. D | Villi area(mm ) 2 Mean ±S. D | CRYPT DEPTH | MUSCUAR THICKNESS |
|---|---|---|---|---|---|
| Control | 815.81 ±18.5 A | 107.82 ±17.6 A | 87968.5 ±190.24 A | 142.50 ± 12.6 A | 79.85 ± 12.3 C |
| 10% | 610.33 ± 16.8 B | 59.43 ±15.7 C | 36277.63 ±163.45 C | 119.86 ± 19.3 B | 99.44 ± 14.2 B |
| 20% | 503.31 ±15.3 C | 73.75 ± 17.2 B | 37122.39 ±127.9 B | 112.96 ±19.6 B | 91.76 ± 14.6 B |
| 30% | 483.72 ± 18.4 D | 43.68 ± 14.8 D | 21130.26 ± 116.77 D | 86.66 ± 12.4 C | 114.12 ± 11.7 A |

In the current study illume Villi length show a significant ($P \leq 0.05$) increase in the control group as compeer with the other groups, while villi width shows a significant ($P \leq 0.05$) increase in the 30 % rice group as compeer with the other groups, villi area shows a significant ($P \leq 0.05$) increase in the control group as compeer with the other group, crypt depth shows a significant ($P \leq 0.05$) increase in the 10 % group as compeer with the other group as shown in table (4)

**Table 4:** effect of basal diet, 10 %, 20% and 30 % rice on ilium Villi

| Groups | Villi length(mm) | Villi width(mm) Mean ±S. D | Villi area(mm)2 Mean ±S. D | CRYPT DEPTH | MUSCUAR THICKNESS |
|---|---|---|---|---|---|
| **Control** | 428.42 ±26.4 A | 90.81 ± 12.1 C | 38905.72 ± 120.6 A | 99.22 ± 8.2 C | 74.385 ± 12.2 B |
| **10%** | 344.11 ± 31.7 B | 106.91 ± 16.4 B | 36792.3 ± 145.7 B | 124.82 ±12.6 A | 108.352 ± 18.6 A |
| **20%** | 347.64 ± 24.6 B | 102.43 ± 9.4 B | 35610.56 ± 160.9 B | 75.55 ± 6.9 D | 72.8685 ± 11.8 B |
| **30%** | 207.85 ± 19.4 C | 122.8 ± 16.9 A | 25525.59 ± 198.4 C | 105.32 ± 10.4 B | 106.4415 ± 14.8 A |

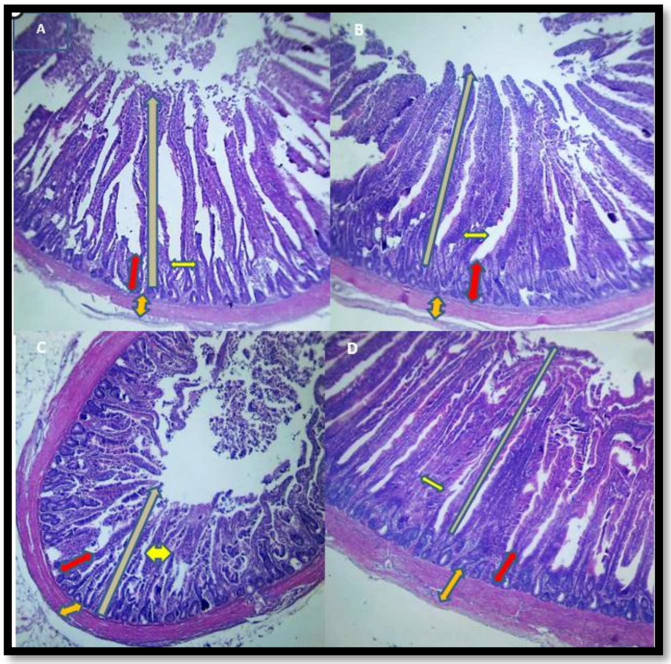


**Figure 1:** effect of basal diet(A) , 10% rice (B), 20% rice (C) and 30 % rice (D) on duodenum villi length (brown arrow) , villi width (yellow arrow), crept depth (red arrow) and muscular thickness(orange arrow) .

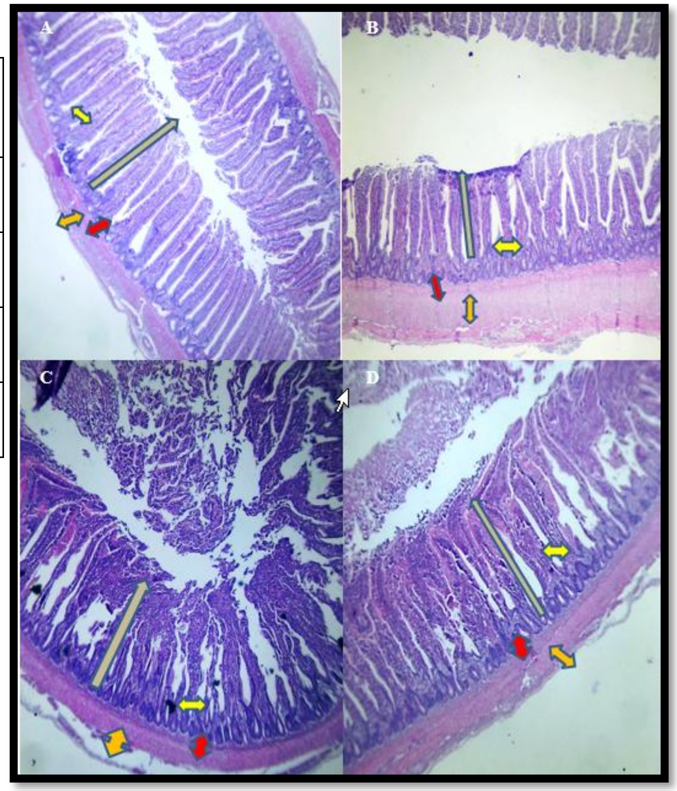


**Figure 2:** effect of basal diet(A) , 10% rice (B), 20% rice (C) and 30 % rice (D) on jejunum villi length (brown arrow) , villi width (yellow arrow), crept depth (red arrow) and muscular thickness(orange arrow) .

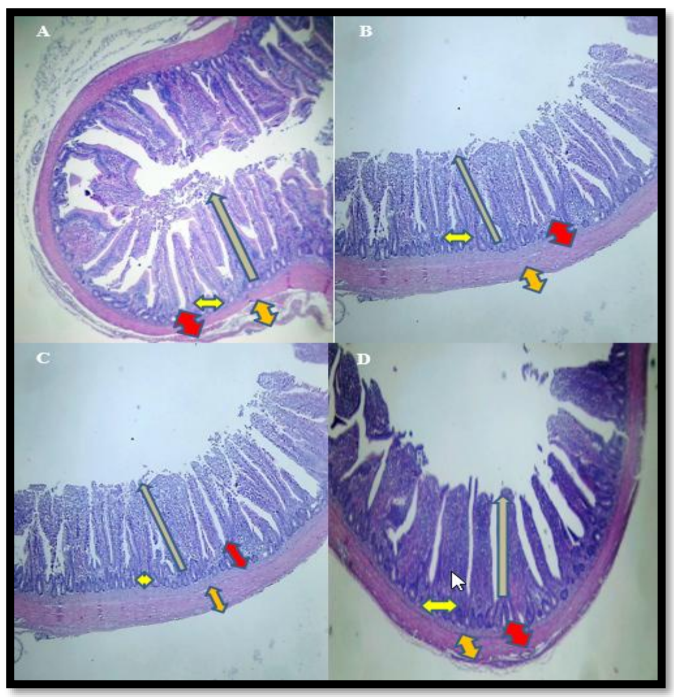


**Figure 3:** effect of basal diet (A), 10% rice (B), 20% rice (C) and 30 % rice (D) on ilium villi length (brown arrow), villi width (yellow arrow), crept depth (red arrow) and muscular thickness (orange arrow).

Through the current study, a decrease in the length, width area & crypt depth of the villi in the groups that contain a high percentage of rice when compared to the control group that does not contain rice. This is observed from Tables (2, 3 &4) and the reason may be that Anti-nutrients that found in the rice can bind to nutrients or enzymes in the gastrointestinal tract in the broilers forming complexes that are difficult to digest or absorb (11). Prolonged exposure to these anti-nutrients may lead to impaired nutrient absorption, including essential vitamins, minerals, and amino acids, which are necessary for maintaining intestinal health and supporting growth in broiler chickens (12).

Some anti-nutrients have pro-inflammatory properties and can induce damage to the intestinal mucosa. Chronic inflammation and tissue damage in the intestinal lining can disrupt the normal structure and function of intestinal villi, leading to a reduction in villi length and surface area available for nutrient absorption (13). Also, high carbohydrate diets, especially those containing fermentable fibers, can promote microbial fermentation in the ceca and colon of broiler chickens, fermentation primarily occurs in the hindgut, it can influence the pH and microbial populations throughout the gastrointestinal tract. Changes in gut microbiota composition and metabolite production may indirectly affect villi length and morphology in the small intestine, imbalance in gut microbiota, has been associated with intestinal inflammation and impaired intestinal barrier function, which can contribute to villi atrophy and compromised nutrient absorption (14,15).

Some anti-nutrients possess antioxidant properties, while others may promote oxidative stress in the gastrointestinal tract. Excessive production of reactive oxygen species (ROS) can damage intestinal cells and impair their ability to regenerate, leading to villi shortening and compromised nutrient absorption (16).

On the other hand, high carbohydrate diets may contribute to nutrient imbalances, such as excessive energy intake relative to protein, vitamins, and minerals. Imbalances in dietary nutrients can impact gut health and villi morphology, as optimal nutrient availability is essential for maintaining the structural integrity of the intestinal epithelium and supporting villi growth and renewal (17).

The study show that there was a significant ($P \leq 0.05$) increase in the ratio of liver, gizzard, proven ticulas & crop in the control group as compeer with the other group as shown in the table (5), this result may occur due to the large weight of the broiler that obtained at the end of the experiment As the percentage of weight of the internal organs is proportional to the weight of the total body, as the body size increases, the weight of the internal organs increases with it(18) . on the other hand, liver in the 30 % rice group show a significant ($P \leq 0.05$) increase as compeer with the 10% and 20 % rice this result may occur due to carbohydrate consumption, excess glucose is converted into glycogen and stored in the liver for future energy needs. Increased carbohydrate intake can lead to greater glycogen storage in the liver, potentially contributing to an increase in liver weight (19).

In the current study spleen show a significant ($P \leq 0.05$) increase in the 30% rice group as compeer with the other group, this result may occur due to high level of anti-nutrient such as phytic acid and tannins have been associated with inflammatory responses in the gastrointestinal tract (20). Chronic inflammation may lead to alterations in organ size and function, including the spleen. Increased spleen weight could be a reflection of systemic inflammation. Changes in spleen weight may serve as an indicator of immune function or inflammatory responses in experimental studies (21).

There is a decrease in the ratio of the intestine weight in the control group when compared to the rest of the other groups. This is due to the large weight of the control group, and this led to a reduction in the ratio of the weight of the intestine organs to the body weight

As broiler chickens consume a high-energy diet to promote rapid growth, the gizzard adapts to the increased workload by growing in size and developing stronger muscular walls. This adaptation allows for better grinding and digestion of the feed aiding in nutrient absorption (18).

## IV. Conclusion

Through the current study conclude that as the amount of rice provided to broiler chickens increases leads to a decrease in the length, width, and crept depth of the villi. Therefore, this can affect the health of the chicken and its absorption of nutrients. It can also affect its weight, size, and the amount of meat in the body.

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