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## GROWTH PERFORMANCE, ORGAN AND CARCASS TRAITS OF BROILER CHICKENS FED DIET CONTAINING PROBIOTICS DIRECT FED MICROBIAL (DFM).

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### ABSTRACT

This research aimed to investigate the impact of incorporating direct fed microbial (DFM) into the diet of broiler chickens on their performance and carcass characteristics. Ninety-six Ross 308 breed day-old chickens were utilized for the study. The birds were assigned randomly to 12 pens, with 24 birds in each treatment and 8 birds per replicate. Four experimental diets were formulated, including a control diet (T1) and three diets with different levels of DFM inclusion (2.5% for T2, 5.0% for T3, and 7.5% for T4). The chickens were assigned to these diets and provided with ad-libitum access to feed and water throughout the 52-day duration of the study.

A complete randomized design (CRD) was employed for the experimental design, and the weights of various carcass parts were measured and recorded. Statistical analysis was conducted on the collected data. The results indicated that there were no significant differences ( $p>0.05$ ) observed among the four treatment diets in terms of initial weight, final weight, daily weight gain, daily feed intake, and feed conversion ratio. However, significant differences ( $p>0.05$ ) were observed in the dressing percentage, wings, hearts, and large intestine. No significant differences ( $p>0.05$ ) were found in the other evaluated parameters. Specifically, T2 (2.5% DFM) exhibited the highest dressing percentage and wing weight, while T3 (5.0% DFM) recorded the lowest values in these two traits. T2 also produced significantly higher dressing percentage and wing weight compared to the other trial diets (T3 and T4). Based on the findings, it can be concluded that broiler diets can be supplemented with up to 2.5% direct fed microbial without any detrimental effects on carcass characteristics.

**Keywords:** Growth, Performance, Probiotic, Direct fed microbial, Broiler chicken

### Introduction

The biggest challenge of commercial poultry production is the availability of good quality feed on a sustainable basis at stable prices (Iyayi, 2008). Despite this challenge, commercial poultry ranks among the highest sources of animal protein (Iyayi, 2008). The increase in the size of the poultry industry has been faster than other food-producing animal industries. The trade volume of poultry products has also increased parallel to the rapid growth of global poultry meat and egg production (Windhorst, 2006). Available statistics indicate that the poultry meat industry has been more dynamic compared with the egg industry over these years (Windhorst, 2006). Feed is the major component of the total cost of production for meat and egg production in the poultry industry.

The poultry industry has become an important economic activity in many countries, with large-scale rearing facilities where poultry are exposed to stressful conditions. Problems related to disease and deterioration of environmental conditions often occur and result in the misuse of antibiotics as growth promoters in animal feed as well as the treatment of animals (Marshall and Levy, 2011). Poultry industry is now facing a ban on the use of antibiotic feed additives for disease prevention and growth-

enhancing supplements. Probiotics have been used to overcome this problem, maintaining the internal microflora by controlling the overgrowth of potential pathogenic bacteria (Raja *et al.*, 2009).

The natural bacterial flora, such as probiotic bacteria, represents a promising alternative therapy. Probiotics are defined as living microorganisms that, upon ingestion in certain numbers, exert health effects beyond the inherent basis of nutrition (Guarner and Sehaafsa, 1998). The role of probiotic microorganisms as a sound alternative to antibiotic growth promoters is to improve the host animal's intestinal microbial balance. So far, a variety of microbial species have been used as probiotics in poultry (Ghadban, 2002; Patterson and Burkholder, 2003).

This research was carried out to determine the effect of the probiotic direct-fed microbial (DFM) on the growth performance and carcass characteristics of broiler chickens.

### Materials and Methods

This study was conducted at the Poultry Unit of the Teaching and Research Farm of Michael Okpara University of Agriculture Umudike, Abia State,

Nigeria, situated at latitude 5° 290N and longitude 70° 330E in the rainforest zone of Southeast Nigeria (NRCRI, Umudike, 2022). The region experiences an annual rainfall of approximately 2177mm, an altitude of 122mm above sea level, and an average ambient temperature ranging from 22°C to 32°C, with relative humidity varying from 50% to 95% depending on the seasons (NRCRI, 2022).

The experimental animals were obtained from Crown Hatchery Nigeria Ltd, Delta State, and the feedstuffs were purchased from Jocan Nig. Ltd, Umuahia, Abia State. The probiotics, Direct Fed Microbial (DFM), were purchased from Eggriculture Inc, USA, and distributed by Farm Associates Nig. Ltd, Enugu State. Ninety-six (96) Ross 308 broiler chickens with an average weight of approximately 50g were randomly divided into four experimental treatments, labeled as T1, T2, T3, and T4. Each treatment had three replicates, with 8 birds per replicate. The inclusion levels of DFM in the diets were 0%, 2.5%, 5%, and 7.5% respectively. The birds in treatment one served as the control group.

The poultry equipment used in the study was washed, cleaned, and disinfected. Heat sources such as electric bulbs, lanterns, and kerosene stoves were regulated throughout the research work. The birds were raised and managed under a deep litter system, with precautions taken to prevent water spillage and feed wastage to avoid introducing pathogens to the birds. The birds were vaccinated against Newcastle disease at day-old and administered anti-stress (Glucose D)

through drinking water upon arrival. Gumboro vaccine was administered against infectious bursal disease on the 7th day. Gendox 10/5, vitality Extra, chick formula, and vitamin were administered as antibiotics. Superhipracox was given for 4 days to prevent coccidiosis, while Amprole 200 and Embazine-forte were used for the prevention of mixed infections. Feed and water were provided ad libitum, and all growth parameters were measured and recorded.

The experimental diets were formulated for broiler starter and broiler finisher stages, with different levels of probiotics/DFM. The composition of the diets is shown in Table 1 and 2. Data collection included measurements of total feed intake, daily weight gain, feed conversion ratio, mortality, and carcass characteristics of the broiler chickens. For each treatment, three animals were slaughtered per replicate after an overnight fasting period. Sensitive electronic scales were used to measure carcass parameters, including live weight, dressed weight, defeathered weight, and meat cut parts such as thigh, shank, back cut, breast, and wing weight. The internal organs, including liver, lungs, kidney, heart, and proventriculus, were also weighed, along with the offal, including the head and intestine. The dressing percentage was calculated as the ratio of dressing weight to live weight. All parameters, except defeathered weight, were expressed as a percentage of the live weight.

Table 1: Ingredients Composition of Broiler Starter Experimental Diets

INGREDIENTS %	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Maize (yellow)	50.00	50.00	50.00	50.00
Soya bean meal	25.00	25.00	25.00	25.00
Wheat offal	8.00	8.00	8.00	8.00
Fish meal	3.00	3.00	3.00	3.00
Palm kernel cake	10.00	9.50	9.00	8.50
Bone meal	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Vitamin/min Premix	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Crude protein	95.95	22.93	22.91	22.89
ME (Kcal/ kg)	2945	2930	2945	2950
Level of inclusion of probiotic (DFM)	0(Control)	2.5	5	7.5

Premix supplied per kg of starter diets vitamin A, 1500, vitamin D3 1300 I<sub>u</sub>, Thiamine 2mg, Riboflavin 6mg, pyridoxine 4mg, Nacl 40mg, Cobalmine 0.05g, Biotic 0.08g, Chlorine chloride 0.05g, Manganese 0.096g, Zinc 0.06g, Iron 0.024g, Copper 0.006g, Iodine 0.014g, Selenium.

Table 2: Ingredient Composition of the Broiler Finisher Experimental Diets.

INGREDIENTS (%)	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
Maize (Yellow)	52.00	52.00	52.00	52.00
Soya bean meal	20.00	20.00	20.00	20.00
Wheat offal	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00
Palm kernel cake	11.00	10.50	10.00	9.50
Bone meal	3.00	3.00	3.00	3.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Vitamin/min premix	0.25	0.25	0.25	0.25
Total	100	100	100	100
Crude protein	20.86	20.53	20.34	20.22
M E (Kcal/kg)	3050	3062	3068	3071
Level of inclusion of probiotics (DFM)	0(Control)	2.5	5	7.5

Premix supplied per kg of finisher diet vitamin A 10,000, vitamin D3 12000 I $\mu$ , Vitamin E, 20 I $\mu$ , Thiamin 2mg, Riboflavin 3mg, pyridoxine 4mg, Nacin 20mg, cobalamin, 0.05g, Biotic 0.08mg, chlorine chloride 0.02g, folic acid 0.5mg, manganese 0.006g, Zinc 0.03g, Iron 0.024g, Copper 0.006g, Iodine 0.0014g, selenium 0.25mg, Cobalt 0.02g.

## Results and Discussion

The growth performance of broiler chickens was evaluated in this study by comparing diets containing different levels of direct fed microbial (DFM). Table 3 presents the results obtained. Statistical analysis revealed no significant differences ( $p > 0.05$ ) in initial weight, final weight, daily weight gain, daily feed intake (DFI), and feed conversion ratio (FCR) among the four treatment diets. The control diet (T<sub>1</sub>) exhibited similar performance to the trial diets (T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>). Thus, the findings suggest that up to 7.5% inclusion of DFM in broiler chicken diets does not have any detrimental effects. Although the final weight of the control diet (T<sub>1</sub>) was higher (2,700 g) compared to the values recorded for the trial diets, the differences were not statistically significant. A similar observation was made for daily weight gain. The daily feed intakes of the trial diets (T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>) were higher than that of the control diet, although not significantly different. The control diet also exhibited a numerically lower and better FCR than the trial diets. However, these differences were not statistically significant, indicating that the control diet performed similarly to the trial diets.

The decision to include DFM and determine its inclusion level is based on the anticipated benefits. It was expected that probiotics would enhance digestion and utilization of food, resulting in better performance in the trial diets (T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>) compared to the control diet (T<sub>1</sub>) in terms of higher daily weight gain, higher final weight, and lower FCR. The commercial application of DFM aims to increase economic profitability by achieving three expectant outcomes: a demonstrable increase in animal performance, a reduction in morbidity and mortality rates, and a

decrease in populations of human pathogenic bacteria (Flint and Garner, 2015).

Traditionally, antibiotics were commonly used as growth promoters in broiler chickens. However, the potential hazards associated with antibiotic growth promoters (AGP) have led to a shift towards the use of probiotics, which provide similar results without the associated risks. Probiotics consist of living microorganisms, either mono- or mixed cultures, that improve the properties of the host's indigenous microflora and exert beneficial effects (Ghadban, 2002). Salim et al. (2013) found that DFM, which contains a mixture of beneficial microorganisms, can be a viable alternative to antibiotics in broiler diets. Their results showed that dietary AGP and DFM supplementation significantly increased body weight gain in broilers during the first 21 days. Feed intake was reduced, while feed conversion was significantly improved when birds were fed DFM from 0 to 7 days of age. Probiotics, including lactobacilli and bifidobacteria, have been successfully used in poultry feeds to promote growth, modulate intestinal microflora and pathogen inhibition, and enhance meat quality (Kavir, 2009).

The DFM used in this study comprised a mixture of organisms, including *L. acidophilus*, *Bifidobacterium thermophilus*, and *Enterococcus faecium*. Bacteria, particularly lactic acid bacteria of the genus *Lactobacillus* and *Bifidobacterium*, have been commonly reported as probiotics in poultry (Sato *et al.*, 2009; Taheri *et al.*, 2009; Lee *et al.*, 2010; Willis *et al.*, 2010; Patterson and Burkholder, 2003). *Enterococcus* and other bacteria, such as *Bacillus*, *Streptococcus*, *Lactococcus*, and *Pedococcus*, have been used to a lesser extent as probiotics.

**Table 3: Growth Performance of Broiler Chickens Fed Diets Containing Different Levels of Direct Fed Microbial**

Parameter	T <sub>1</sub> 0%	T <sub>2</sub> 2.5%	T <sub>3</sub> 5%	T <sub>4</sub> 7.5%	SEM
Initial weight (g)	50.00	50.00	50.00	50.00	0.00
Final weight (g)	2700.00	2466.67	2566.67	2566.67	77.97
Daily weight gain (g/day)	47.32	43.15	44.94	44.94	1.39
Daily feed intake (g/day)	164.62	190.30	176.67	182.45	4.56
Feed conversion ratio	3.49	4.53	3.93	4.08	0.19

Means did not differ significantly at  $p > 0.05$ ; SEM = Standard error of the mean

#### Organs and Carcass traits of broiler chickens fed diets containing different levels of direct fed microbial.

The results of organ and carcass traits of broiler chickens fed different levels of DFM is presented in Table 4. Significant differences ( $p < 0.05$ ) were observed in dressing percent, wings, heart, and large intestine. However, no significant differences ( $p > 0.05$ ) were observed in the other parameters. Among the different levels of DFM supplementation, the 2.5% DFM showed the most significant values for dressing percent and wing weight, while the 5% DFM (T<sub>3</sub>) showed the least values in these two traits. In contrast, T<sub>4</sub> (7.5% DFM) recorded the highest value ( $p < 0.05$ ) for large intestine weight as a percentage of liveweight, compared to T<sub>1</sub>, T<sub>2</sub>, and T<sub>3</sub> which were similar. The higher large intestinal weight of T<sub>4</sub> may be attributed to the level of DFM used in the diet, which increased the weight of the large intestine. The control diet showed the highest heart weight, followed by T<sub>2</sub> and T<sub>3</sub>, while T<sub>4</sub> recorded the least value. Consequently, the supplementation of broiler chicks' diet with DFM led to a decline in heart weight as the level of supplementation increased.

The findings of this study regarding carcass performance and DFM supplementation are consistent with some previous research but contradict others. Mohamed *et al.* (2015) reported no significant effects of dietary probiotics on dressing percentage and the relative weights of the heart, gizzard, and abdominal fat, which contradicts the results observed in this study for dressing percent and heart weight but agrees with abdominal fat and gizzard. Similarly, Karaoglu and Durdag (2005) and Rezaei pour *et al.* (2012) found no effect of dietary probiotics on carcass characteristics, which disagrees with the significant parameters observed in this study. However, other researchers have shown that probiotics significantly improve carcass characteristics of broiler chickens (Paryad and Mahmoudi, 2008; Zhang, 2006; Kannan *et al.*, 2005; Panda *et al.*, 2000; Onifade *et al.*, 1998; Jin *et al.*, 1998; Haj Ayed *et al.*, 2004; Sultan *et al.*, 2006; Chumpawadee *et al.*, 2008). The results of this study also demonstrate significant increases in dressing percent, wing weight, heart weight, and large intestinal weight, consistent with previous findings.

Dressed weight and dressing percent are crucial indicators of carcass performance in broiler chickens. Kabir *et al.* (2004) and Mahajan (1999) reported significantly higher carcass yield in broiler chicks fed with probiotics at different ages, contradicting the present findings. Bonsu *et al.* (2012) indicated that dietary DFM had no significant effect on dressing percent, which contradicts the present findings. However, Mahajan *et al.* (1999) reported significant variations in dressing percent of broiler birds fed dietary probiotics (Lacto-sacc), in agreement with the results of this study. These variations in dressing percent may be associated with the species of beneficial microbes used in this study. The dressing percent and wing weight per percent live weight were most significant in T<sub>2</sub>, but inconsistencies arose as the level of DFM supplementation increased. In T<sub>2</sub>, dressing percent and wing weight increased, but at the 5% DFM level, they declined, followed by an increase at the 7.5% DFM level in T<sub>4</sub>. This inconsistency suggests that other factors may have influenced the results. One possible factor is the presence of less viable microbes in T<sub>3</sub>.

Recent studies by Kalavathy *et al.* (2003) and Yusrizal and Chan (2003) found that supplementation of probiotics significantly reduced abdominal fat pad. In this study, the trial diets containing DFM probiotics showed lower abdominal fat compared to the control, although not significantly reduced. This suggests that the DFM used in this study may interfere with fat deposition in the carcass. Mohamed *et al.* (2015) and Boostani *et al.* (2013) recorded significant thigh and breast values for broilers fed diets supplemented with probiotics, contradicting the results obtained in this study.

Studies by Mohamed *et al.* (2015), Dimcho *et al.* (2005), Pekoe *et al.* (2004), and Ivanov (2004) reported improvements in liver, gizzard, and heart weight of broilers by supplementing diets with probiotics. In this study, the internal organs of the trial diets were compared with the control diet, except for heart weight, which was significantly reduced in the trial diets. Bonsu *et al.* (2012) indicated that dietary DFM and antibiotics supplementation may not have a significant influence or adverse effect on the weight of internal organs in broiler chickens, in agreement

with Mandal *et al.* (2000) and Mohan *et al.* (1996). The observations of these researchers are similar to the findings of this study for all internal organs except heart weight, which showed significant differences among the treatment diets. The control diet had a higher heart weight than the trial diets. As heart weight declined, intestinal weight increased with the level of DFM supplementation. A reduction in heart weight may result in abnormal blood pumping and poor circulation. The higher weight of the large intestine in T4 may be connected to inefficient nutrient digestion, thereby exerting more pressure in the large intestine due to accumulated excreta in the colon. The need to accommodate more undigested nutrients could lead to mitotic division and consequent enlargement of the large intestine in T4.

As noted earlier, heart weight reduced as the level of DFM supplementation in the diet increased, with the highest reduction observed in T4 (7.5% DFM). A reduction in heart weight can impair the normal function of the heart in terms of blood circulation and transportation of nutrients, oxygen, enzymes, and other materials. Awad *et al.* (2006) and Bonsu *et al.* (2012) did not observe a reduction in heart weight with the administration of DFM in broiler chicken diets. Rosbeh *et al.* (2013) showed that the independent administration of two probiotics led to a reduction in heart weight, but the combined administration improved heart weight to that of the control diet. This suggests that the species and mode of interaction of probiotic organisms, as well as their inclusion as single or multiple organisms, may have affected the current results.

Awad *et al.* (2008) reported that probiotics can increase small intestine and colon lengths. They noted that the small and large intestines of birds have high absorptive rates for water and electrolytes. The higher intestinal weight observed in T4 appears abnormally high compared to the values established for the control diet and the other trial diets. This implies that the increase may not solely be beneficial in terms of re-absorption of water and electrolytes but may be due to accumulated undigested materials in the colon resulting from poor absorption in the small intestine and competition for the host's food by the increased number of DFM in the small intestine of broiler chickens in T4. Kabir *et al.* (2005) demonstrated that broilers fed with probiotics displayed pronounced intestinal histological changes, such as active impetus in cell mitosis and

increased nuclear size of cells, compared to the controls. The higher large intestinal weight observed in T4 (7.5% DFM) may have resulted from active impetus to cell mitosis, leading to increased intestinal weight. However, it would have been preferable if the increase occurred in the small intestine, which is responsible for food absorption, rather than the large intestine. Most previous research has focused more on the improved effects of probiotics on small intestine morphology. Moosavinasab and Ghiasi (2011) showed that adding probiotics increased the length of the small intestine in broiler chickens. Awad *et al.* (2006) demonstrated an improvement in small intestinal morphology with the administration of probiotics. Rosbeh *et al.* (2013) also showed that the addition of probiotics increased jejunum crypt depth, villus width, and epithelial thickness, although the increase was not significantly different from the control. The highest small intestinal weight recorded for T2 in this study might be a result of improved histological conditions of the small intestine, particularly the villi structures. This improvement in T2 was reflected in the highest dressing percent and wing weight expressed as a percentage of live weight. The 2.5% DFM level appeared to be the most effective in terms of the observed improvements. According to Rosbeh *et al.* (2013), increasing jejunum villus width improved the absorption of food material in broiler chickens at 42 days of age.

Several factors, including heat, antibiotics specificity, viability of the beneficial microbial organisms, mode of administration, mode of action of probiotics, diseases, basal diet, and environmental conditions, could have influenced the differences between this research and previous studies (Mohamed *et al.*, 2015; Kabir *et al.*, 2004; Boostani *et al.*, 2013). Huang *et al.* (2004) noted that the strain of selected microorganisms in probiotics, method of preparation, dosage, and animal conditions could be responsible for variable performance results. Flint and Garner (2015) similarly attributed variable results with the use of probiotics to factors such as insufficient viable organisms delivered to the animals, improper manufacturing of the product, inclusion of inappropriate organisms, or impairment of bird performance by infectious agents not affected by the DFM product used.

**Table 4: Organ and Carcass traits of broiler chickens fed diets containing different levels of direct fed microbial.**

Parameter	T <sub>1</sub> 0%	T <sub>2</sub> 2.5%	T <sub>3</sub> 5%	T <sub>4</sub> 7.5%	SEM
Live weight (lwt) (g)	1966.67	2033.33	1966.67	1850.00	38.66
Defeathered weight (g)	1740.00	1850.00	1666.67	1675.00	35.89
Dressed weight (g)	1352.67	1440.33	1299.00	1279.50	33.22
Dressing percent	68.77 <sup>ab</sup>	70.85 <sup>a</sup>	65.89 <sup>b</sup>	69.24 <sup>ab</sup>	0.78
<b>Cut parts as % of liveweight</b>					
Abdominal fat	1.14	0.92	0.88	1.01	0.10
Breast weight	18.22	20.70	19.77	18.52	0.62
Back cut	14.68	14.65	13.17	15.12	0.37
Shank	3.78	3.65	3.42	3.40	0.14
Thigh	11.19	11.42	9.85	10.42	0.25
Drumstick	8.90	8.69	8.39	9.27	0.18
Wings	8.79 <sup>ab</sup>	8.66 <sup>a</sup>	8.05 <sup>b</sup>	8.78 <sup>ab</sup>	0.18
<b>Offals/Organs as % of liveweight</b>					
Head	2.58	2.81	2.84	2.76	0.13
Neck	3.21	3.08	3.24	3.73	0.13
Crop	0.44	0.43	0.36	0.51	0.03
Proventriculus	0.58	0.64	0.50	0.54	0.02
Spleen	0.12	0.15	0.12	0.14	0.01
Liver	2.12	2.06	1.94	2.22	0.05
Heart	0.53 <sup>a</sup>	0.46 <sup>ab</sup>	0.50 <sup>ab</sup>	0.43 <sup>b</sup>	0.02
Kidney	0.37	0.56	0.50	0.53	0.05
Gizzard	2.09	2.09	2.17	1.98	0.08
Small intestine	3.27	3.53	3.05	3.25	0.15
Large intestine	0.41 <sup>b</sup>	0.44 <sup>b</sup>	0.43 <sup>b</sup>	0.62 <sup>a</sup>	0.03
Lungs	0.61	0.61	0.68	0.65	0.04

a,b Means across rows differed significantly at  $p < 0.05$ ; SEM = Standard error of the mean

## Conclusion

This study investigated the impact of including direct-fed microbial (DFM) as a probiotic source in the diets of broiler chickens. The results indicated that there were no significant differences in growth performance between the control diet (T<sub>1</sub>) without DFM and the trial diets (T<sub>2</sub>, T<sub>3</sub>, and T<sub>4</sub>) with varying levels of DFM (2.5%, 5%, and 7.5% respectively). However, the trial diets exhibited lower final weights, daily weight gain, and higher feed conversion ratios compared to the control diet, suggesting a tendency towards poorer performance. Carcass evaluation revealed significant variations in dressing percent, wing weight, heart weight, and large intestine weights. Among the treatments, T<sub>2</sub> showed the most notable performance in terms of dressing percent and wing weight, indicating superior performance compared to the other diets. The inclusion of DFM in the diets resulted in reduced heart weight, with T<sub>4</sub> exhibiting the most significant reduction. T<sub>2</sub> also displayed the highest small intestinal weight, indicating better interaction with the DFM, which is associated with improved absorption. Additionally, T<sub>2</sub> showed evidence of better thigh weight, aligning with previous findings on the positive impact of probiotics. While the trial diets exhibited a reduction in abdominal fat, it was not statistically significant in this study. The 7.5% DFM level (T<sub>4</sub>) demonstrated an outstanding increase in

intestinal weight, likely due to poor absorption in the small intestine and competition for food between the DFM and the host, leading to the accumulation of undigested food in the large intestine. However, since the small intestine plays a crucial role in food absorption, the increase in large intestinal weight in T<sub>4</sub> was not considered a significant achievement in this study. Overall, the inclusion of DFM in broiler chickens' diets did not significantly improve or adversely affect their growth performance but yielded variable results in carcass performance across the different treatment diets. Based on the findings, a 2.5% level of DFM inclusion in the diet demonstrated better carcass performance in terms of dressing percent, wing weight, thigh weight, and small intestinal weight, making it a recommended option for adoption by farmers.

## Recommendation

Based on the remarkable characteristics outlined earlier, we strongly recommend incorporating the 2.5% level of Direct-Fed Microbials (DFM) into broiler chicken diets. Furthermore, to validate their effectiveness in enhancing growth performance and carcass characteristics of broiler chickens, it is worth considering the inclusion of additional beneficial organisms like yeast alongside the 2.5% DFM level in future studies.



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