Effect Of *Acacia Nilotica* On The Growth Performance Of Broiler Chickens

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Abstract
The present study aimed to investigate the effect of Acacia nilotica on the growth performance of broiler chickens. The experiment was conducted at the Poultry Husbandry Department, Sindh Agriculture University Tandojam. Different treatment groups were established with varying levels of Acacia nilotica pod supplementation (0%, 3%, 6%, 9%, and 12%) along with a fixed enzyme complex dosage (100 g/kg). A total of 300 broiler chickens were purchased and grouped accordingly. The housing and management practices followed standard protocols, including appropriate temperature maintenance, adequate lighting, and routine vaccinations. Various parameters, such as feed intake, water intake, live body weight, feed conversion ratio (FCR), carcass weight, dressing percentage, and relative organ weights, were recorded and analyzed statistically. The cumulative weight gain of broiler chickens was significantly affected by Acacia nilotica supplementation. The control group (T0) showed the highest cumulative weight gain (2058.33±20.85 g/b), while the group supplemented with 12% Acacia nilotica (T12) exhibited the lowest cumulative weight gain (1756.67±14.33 g/b). Feed intake was also significantly influenced by Acacia nilotica supplementation. The control group (T0) had the highest feed intake (4003.75±20.14 g/b), whereas the group supplemented with 12% Acacia nilotica (T12) had the lowest feed intake (3523.33±27.78 g/b). The feed conversion ratio (FCR), which reflects feed efficiency, was significantly affected by Acacia nilotica supplementation. The group supplemented with 6% Acacia nilotica (T6) showed the lowest FCR (1.90±0.02), indicating better conversion of feed into body weight. In contrast, the group supplemented with 12% Acacia nilotica (T12) had the highest FCR (2.00±0.03), suggesting a less efficient conversion of feed to body weight. Carcass weight, representing the weight of the birds after slaughter, was significantly influenced by Acacia nilotica supplementation. The control group (T0) had the highest carcass weight (1386.75±6.23 g/b), while the group supplemented with 12% Acacia nilotica (T12) had the lowest carcass weight (1136.61±16.49 g/b). The dressing percentage, which indicates the proportion of carcass weight to live weight, was significantly affected by Acacia nilotica supplementation. The group supplemented with 6% Acacia nilotica (T6) showed the highest dressing percentage (68.55±0.29%), while the group supplemented with 12% Acacia nilotica (T12) had the lowest dressing percentage (64.69±0.43%). The significantly ($p<0.05$) lower fat pad (34.96±1.95%) was noted in T12, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex, compared to T9 (37.36±2.01%), T6 (40.08±2.43%), and T3 (41.39±2.27%), respectively. These groups received supplementation with 9%, 6% and 3% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the fat pad (44.11±1.91%) were recorded higher in T0 group (control). Acacia nilotica supplementation had varying effects on the growth performance of broiler chickens. While lower levels of supplementation (3% and 6%) resulted in improved weight gain, feed intake, and feed conversion ratio, higher levels (9% and 12%) showed negative effects on these parameters. These findings highlight the importance of optimizing the dosage of Acacia nilotica supplementation in broiler chicken diets to achieve optimal growth performance.

Keywords: Acacia nilotica, broiler chickens, growth performance, feed intake, feed conversion ratio, carcass weight, dressing percentage, relative organ weights.

1.0 Introduction

Poultry production worldwide contributes more than 30% of protein for human consumption through meat, eggs, and their products (Hafiz et al., 2015; Motsepe et al., 2016). Rosegrant et al. (2001) reported that there is high demand for poultry meat. This is attributed to the high nutritional value and affordability of poultry meat when compared to other animal protein supplies (Hafiz et al., 2015). As a result, the poultry industry continues to grow year in and year out making it a significant contributor to global food security, income, and employment opportunities particularly for rural- based communities (Mbajiorgu et al., 2007). Seasonal changes including climate change and drought conditions affect the quantity and quality of feed raw materials which result in shortages and high poultry feed costs (Mthethwa, 2018). The hike in feed costs is mainly on protein and energy feed ingredients which adversely affect poultry industries, especially commercial and smallholder poultry farmers.

The growth performance of broiler chickens is a critical aspect of the poultry industry. Broilers are a specific breed of chicken that is raised primarily for meat production. Their growth rate, feed efficiency, and overall performance have a direct impact on the profitability and success of broiler production operations (Wapi et al., 2013). Over the years, extensive efforts have been made to enhance the growth performance of broiler chickens through genetic selection, improved nutrition, and advanced management practices. These advancements have resulted in significant improvements in growth rates and feed conversion efficiency, allowing broilers to reach market weight in a shorter time while efficiently converting feed into meat (Cunha et al., 2018; Mthethwa, 2018).

Feeding forages can be beneficial to poultry farmers as they can reduce the dependence on the traditional protein and energy feed ingredients. Hence, various forage species, including Acacia meals can be used as alternative protein sources for livestock species (Tufarelli et al., 2018). The inclusion of leaf meals in broiler diets helps to lessen the use of protein-rich feedstuffs by partially replacing them, consequently, reducing feed costs (Sugiharto et al. 2019). Some Acacia meals often used in poultry diets include *Acacia angustissima*, *Acacia tortilis*, *Acacia karroo*, *Acacia saligna*, and *Acacia schaffneri*. The inclusion of *Acacia angustissima* in broiler diets to improve growth and carcass characteristics has been well documented. This species shows a greater potential to be used as a protein feed source to partially replace common protein sources in broiler diets (Ncube et al., 2012; Ncube et al., 2017a; Madzimure et al., 2018; Gudiso et al., 2019). *Acacia angustissima* meal can be used efficiently as a crude protein source in broiler diets when it is harvested at the mid maturity stage to maximize crude protein and condensed tannin levels (Ncube et al., 2015). *Acacia tortilis* meal can help reduce the portion of other protein ingredients in broiler diets by partially replacing them without any detrimental effect on performance and carcass yield (Miya, 2019 Ikiamba et al., 2020). *Acacia karroo* leaf meals have the potential to be used as additives in poultry diets at lower levels (Ngambi et al., 2009). *Acacia schaffneri* seed meal can effectively be used in the backyard production system to partially replace expensive protein and energy feed sources in poultry diets (Fuentes et al., 2012). *Acacia saligna* leaf meal can be utilised in chicken diets without any negative effects on their performance and further recommended its use (Abd El-Galil et al., 2018).

In addition, dietary tannins inclusion from Acacia meals in diets reduced fat deposition in broiler chickens (Ng'ambi et al., 2009; Hafeni, 2013). The most common Acacia species includes *Acacia karroo*, *Acacia tortilis*, *Acacia nilotica*, *Acacia angustissima*, *Acacia saligna* and *Acacia scaffneri*. Although they have high crude protein content, their utilisation, anti-nutritional factors (amount and types of tannins), viability, and palatability need to be taken into consideration as they affect animal performance (Mokoboki et al., 2005; Anon, 2009; Hassan and Abd El- Dayem, 2019).

Tannins are among the important anti-nutritional factors of various browse trees, including Acacia species (Mlambo et al., 2009). Nutritional effects of tannins depend on tannin concentration, molecular weight, and structure, as well as animal factors (Mlambo et al., 2015). According to Sugiharto et al. (2019), low tannins inclusion in poultry diets has a positive impact on their health and performance. This is supported by studies that reported that low levels of dietary tannins from Acacia meals improved the growth performance of ruminants (Ngambu et al., 2013) and monogastric animals, more especially broiler chickens (Huang et al., 2018). Other studies observed that low tannins inclusion had no adverse effect on poultry productivity (Cui et al., 2018; Manyelo et al., 2019). However, the utilisation of tannin rich leaf meals can further be improved by various techniques such as soaking feed with alkaline or water solutions (Nawab et al., 2020), sun drying, cooking, fermentation (Sugiharto et al., 2019), detannification process with wood ash then store at room temperature (Brown et al., 2016; Nawab et al., 2020), dilution, extraction using organic solvents, biodegradation by white-rot fungi, the use of Magadi soda containing alkalies (sodium carbonate, sodium bicarbonate, and sodium sesquicarbonate) (Ben Salem et al., 2005) and the use of binding agents such as polyethylene glycol and polyvinyl pyrrolidone to extract tannin compounds from plants and effectively assist in reducing anti-nutritional factors (Nsahlai et al., 2011).

However, there is limited information on the use of Acacia meals as a protein source in the diets of other poultry species such as indigenous chickens, ducks, turkeys, ostriches, and guinea fowls to improve productivity and reduce feed costs. Keeping in view the facts stated above, therefore this study was conducted to evaluate the effect of *Acacia nilotica* on the growth performance of broiler chickens.

2.0 Materials and Methods

2.1 Area of study: The study on *Acacia Nilotica*, a useful alternative feed ingredients for economical poultry production was conducted at Poultry Husbandry Department, Sindh Agriculture University Tandojam. The following treatment plan was used for this experiment.

Table 2.1 Treatment plan

Treatment Groups	T0	T3	T6	T9	T12
***Acacia Nilotica* Pod %**	0	3	6	9	12
Enzyme g/Kg	100	100	100	100	100
Total Chicks	60	60	60	60	60

2.2 Collection and processing of Acacia pods: Acacia pods were collected from the surrounding areas of Tandojam and brought to Sindh Agriculture University Tandojam for further processing. Initially, the Acacia pods were processed for cleaning and evaluation of chemical compositions. Commercial enzyme complex was used to treat the pods chemically.

Dried pods were grinded and pellet at a specific temperature under steam treatment. Acacia pods were analysed for Ash, Protein, Fat and Ash % by the method AOAC, 2000

2.3 Grouping: A total of 300 broilers were purchased from Local Hatchery Hyderabad, bought to the Poultry Experimental Station, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. The birds were grouped according to following design.

Groups	T0	T3	T6	T9	T12
No. of birds purchased	60	60	60	60	60
No. of replicated	3	3	3	3	3
No. of birds / replicate	20	20	20	20	20

2.4 Housing and Management: The floor space was provided ½ sq. ft. per broiler during the brooding period (1^{st} phase 1 to 21 days) and 1 sq. ft. during lateral stage of rearing (2^{nd} phase 22 to market of birds). The shed was initially washed with water and later on washed with phenyl disinfectant. The shed was left to dry for 24 hours. The wooden dust was dried in sunlight and used as a litter material. The lime stone was mixed at the rate 2 percent as disinfectant. The litter was used as a two inch thick layer for comfort to chicken. During the brooding period (1-3weeks), proper temperature was maintained i.e. 90-95ºF during the first week by using an electric brooder fitted with a 40/60 watt electric bulb. At first day sugar was offered to chicks for flushing. The feed and water were offered *ad libitum*. Two drinkers and two feeders were provided to each group. The feed and water refusal from each group was weighed and measured daily in the morning. The 23 hours lighting was provided throughout experimental period and bulbs were hanged at the height of eight feet in the shed. Routine vaccination was performed in all birds.

2.5 Parameters recorded

2.5.1 Feed intake: The total feed intake was measured by feeding birds with already weighed feed at *ad libitum* twice a day with a gap of six hours and deducting the left-over feed in each groups out of total offered feed in each group on daily basis.

Feed intake (g/b/d) = Total feed offered – Total feed refused

2.5.2 Water intake: The total water intake was measured *ad libitum* twice a day with a gap of six hours and deducting the left-over water in each groups out of total offered feed in each group on daily basis.

Water intake (g/b/d) = Total water offered – Total water refused

2.5.3 Live body weight: 09 birds were randomly selected from each group than initially and weekly weighted using Digital weighing balance.

2.5.4 Feed conversion ratio (FCR): Feed conversion ratio was calculated on the basis of total feed consumed by a broiler bird for gaining one kg weight. Thus, the feed conversion ratio is actually the feed consumed by the average broiler for achieving one kg live body weight.

FCR = Total feed intake / Total live body weight

2.5.5 Carcass weight (g/b): After completing 42 days of experimental trial, four broilers/replicate was randomly collected, weighed and slaughtered. After dissecting, the carcass weight was recorded using following formula.

Carcass weight = Carcass weight × 100

Total live body weight

Carcass weight was expressed in percentage.

2.5.6 Internal organ weight

The weight of internal organs was recorded from four slaughtered broilers of each replicate. The internal organs include heart, liver, kidney, spleen, and intestine was weighed and calculated as relative weight using following formula;

Relative weight of the organ = Organ weight x 100

Total live body weight

2.6 Statistical Analysis: Statistical analyses were performed using JMP software, (SAS USA) and all data were expressed as means ± SD values. Comparisons of the mean values were performed by one-way analysis of variance. Significant differences among means were evaluated by Tukey's comparison test at $P< 0.05$.

3.0 Results

3.1 Cumulative weight gain (g/b): Table 3.1 illustrates the outcomes regarding the impact of *Acacia nilotica* on the cumulative weight gain of broiler chickens. The cumulative weight gain of the broiler chickens was significantly ($p<0.05$) influenced by varying levels of *Acacia nilotica* supplementation. The results showed that there was a significantly higher cumulative weight gain (2058.33±20.85 g/b) in the group denoted as T0 (control), compared to the groups T3 (2033.33±16.49 g/b), T6 (2018.33±24.69 g/b), and T9 (1853.33±18.40 g/b), these groups were supplemented with 3%, 6%, and 9% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. Conversely, the T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex exhibited a lower cumulative weight gain (1756.67±14.33 g/b).

3.2 Feed intake (g/b): In Table 3.2, the results demonstrate the effects of *Acacia nilotica* supplementation on the feed intake of broiler chickens. The feed intake of the chickens was significantly influenced by different levels of *Acacia nilotica* supplementation. The group denoted as T0 (control), exhibited a significantly higher feed intake (4003.75±20.14 g/b) compared to the groups T9 (3964.00±40.47 g/b), T3 (3886.67±13.12 g/b), and T6 (3838.33±27.56 g/b). These groups received supplementation with 9%, 3%, and 6% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. Conversely, the T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex showed a lower feed intake (3523.33±27.78 g/b).

Table 3.1 Effect of *Acacia nilotica* on cumulative weight gain (g/b) of broiler chicken

Treatments	Mean±SE
T0 (Control)	2058.33±20.85^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2033.33±16.49^{a}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2018.33±24.69^{a}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1853.33±18.40^{b}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1756.67±14.33^{c}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0001	

Table 3.2 Effect of *Acacia nilotica* on feed intake (g/b) of broiler chicken

Treatments	Mean±SE
T0 (Control)	4003.75±20.14^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	3886.67±13.12^{ab}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	3838.33±27.56^{b}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	3964.00±40.47^{c}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	3523.33±27.78^{d}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0001	

3.3 FCR: Table 3.3 presents the results regarding the influence of *Acacia nilotica* supplementation on the feed conversion ratio (FCR) of broiler chickens. The FCR, which reflects the efficiency of converting feed into body weight, was significantly impacted by the varying amounts of *Acacia nilotica* supplementation. Notably, the group denoted as T6, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex, displayed a significantly lower FCR (1.90±0.02) compared to the groups T3 (1.91±0.02), T0 (1.94±0.01), and T9 (1.99±0.01). These groups received supplementation with 3%, 0%, and 9% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. In contrast, the T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex exhibited a higher FCR (2.00±0.03), indicating a less efficient conversion of feed to body weight.

3.4 Carcass weight (g/b): Table 3.4 presents the findings concerning the impact of Acacia nilotica supplementation on the carcass weight of broiler chickens. The carcass weight, which represents the weight of the birds' bodies after slaughter, was significantly influenced by different levels of *Acacia nilotica* supplementation. Significantly higher carcass weights (1386.75±6.23 g/b) were recorded in the group denoted as T0 (control), compared to the groups T6 (1383.40±11.78 g/b), T3 (1348.37±12.30 g/b), and T9 (1238.38±12.30 g/b), these groups were supplemented with 6%, 3%, and 9% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. Conversely, the T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex exhibited a lower carcass weight (1136.61±16.49 g/b).

Table 3.3 Effect of *Acacia nilotica* on FCR of broiler chicken

Treatments	Mean±SE
T0 (Control)	1.94±0.01^{ab}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1.91±0.02^{ab}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1.90±0.02^{b}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1.99±0.01^{ab}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.00±0.03^{a}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0223	

Table 3.4 Effect of *Acacia nilotica* on carcass weight (g/b) of broiler chicken

Treatments	Mean±SE
T0 (Control)	1386.75±6.23^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1348.37±12.30^{a}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1383.40±11.78^{a}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1238.38±12.30^{b}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	1136.61±16.49^{c}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0001	

3.5 Dressing (%): The findings from Table 3.5 showing the effects of *Acacia nilotica* supplementation on the dressing percentage of broiler chickens. The dressing percentage represents the proportion of the carcass weight in relation to the live weight of the birds. The results indicate that the dressing percentage of broiler chickens was significantly influenced by different levels of *Acacia nilotica* supplementation. Notably, the group denoted as T6, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex, exhibited a significantly higher dressing percentage (68.55±0.29%) compared to the groups T0 (67.38±0.39%), T9 (66.82±0.57%), and T3 (66.31±0.54%). These groups received supplementation with 0%, 9%, and 3% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. On the other hand, the T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex, demonstrated a lower dressing percentage (64.69±0.43%).

3.6 Relative weight of heart (%): Results on the effect of *Acacia nilotica* on relative weight of heart (%) of broiler chickens is presented in Table 3.6. Relative weight of heart (%) of broiler chicken was not affected by different amount of *Acacia nilotica* supplementation. The non-significantly ($p>0.05$) higher relative weight of heart (0.84±0.04%) was noted in T0 (control) compared to T12 (0.80±0.07%), T3 (0.71±0.03%) and T9 (0.66±0.03%), respectively. These groups received supplementation with 12%, 3%, and 9% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the relative weight of heart (0.63±0.05%) were recorded lower in T6 group, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex.

Table 3.5 Effect of *Acacia nilotica* on dressing (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	67.38±0.39^{ab}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	66.31±0.54^{bc}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	68.55±0.29^{a}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	66.82±0.57^{ab}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	64.69±0.43^{c}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0005	

Table 3.6 Effect of *Acacia nilotica* on relative weight of heart (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	0.84±0.04^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.71±0.03^{a}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.63±0.05^{a}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.66±0.03^{a}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.80±0.07^{a}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0488	

3.7 Relative weight of liver (%): Results on the effect of *Acacia nilotica* on relative weight of liver (%) of broiler chickens is presented in Table 3.7. Relative weight of liver (%) of broiler chicken was significantly affected by different amount of *Acacia nilotica* supplementation. The significantly ($p<0.05$) higher relative weight of liver (3.06±0.07%) was noted in T3 group, where the birds were supplemented with 3% *Acacia nilotica* along with a 100 mg/kg enzyme complex compared to T12 (2.85±0.07%), T0 (2.74±0.07%) and T6 (2.40±0.26%), respectively. These groups received supplementation with 12%, 0%, and 6% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the relative weight of liver (2.35±0.07%) were recorded lower in T9 group, where the birds were supplemented with 9% *Acacia nilotica* along with a 100 mg/kg enzyme complex.

3.8 Relative weight of spleen (%): Results on the effect of *Acacia nilotica* on relative weight of spleen (%) of broiler chickens is presented in Table 3.8. Relative weight of spleen (%) of broiler chicken was significantly affected by different amount of *Acacia nilotica* supplementation. The significantly ($p<0.05$) higher relative weight of spleen (0.16±0.01%) was equally noted in T0 (control) and T12 group, where the birds were supplemented with 12% *Acacia nilotica* along with a

100 mg/kg enzyme complex compared to T9 (0.14±0.01%) and T3 (0.13±0.01%), respectively. These groups received supplementation with 9% and 3% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the relative weight of spleen (0.09±0.01%) were recorded lower in T6 group, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex.

Table 3.7 Effect of *Acacia nilotica* on relative weight of liver (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	2.74 ± 0.07^{ab}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	3.06 ± 0.07^{a}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.40 ± 0.26^{b}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.35 ± 0.07^{b}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.85 ± 0.07^{ab}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0107	

Table 3.8 Effect of *Acacia nilotica* on relative weight of spleen (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	0.16 ± 0.01^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.13 ± 0.01^{ab}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.09 ± 0.01^{b}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.14 ± 0.01^{ab}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.16 ± 0.01^{a}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0021	

3.9 Relative weight of gizzard (%): Results on the effect of *Acacia nilotica* on relative weight of gizzard (%) of broiler chickens is presented in Table 3.9. Relative weight of gizzard (%) of broiler chicken was not affected by different amount of *Acacia nilotica* supplementation. The non-significantly (p>0.05) higher relative weight of gizzard (2.17±0.07%) was noted in T6, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex, compared to T12 (.13±0.07%) and T0 (2.08±0.07%), respectively. These groups received supplementation with 12% and 0% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the relative weight of gizzard (2.00±0.07%) were recorded lower in T3 and T9 groups, where the birds were supplemented with 3 and 9% *Acacia nilotica* along with a 100 mg/kg enzyme complex.

3.10 Relative weight of proventriculus (%): Results on the effect of *Acacia nilotica* on relative weight of proventriculus (%) of broiler chickens is presented in Table 4.10. Relative weight of proventriculus (%) of broiler chicken was not affected by different amount of *Acacia nilotica* supplementation. The non-significantly (p>0.05) higher relative weight of proventriculus (0.45±0.01%) was noted in T3, where the birds were supplemented with 3% *Acacia nilotica* along with a 100 mg/kg enzyme complex, compared to T9 (0.43±0.01%), T12 (0.42±0.01%) and T0 (0.41±0.01%), respectively. These groups received supplementation with 3%, 12%, and 0% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the relative weight of proventriculus (0.40±0.01%) were recorded lower in T6 group, where the birds were supplemented with 6% *Acacia nilotica* along with a 100 mg/kg enzyme complex.

Table 3.9 Effect of *Acacia nilotica* on relative weight of gizzard (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	2.08 ± 0.07^{a}
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.00 ± 0.07^{a}
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.17 ± 0.07^{a}
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.00 ± 0.07^{a}
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	2.13 ± 0.07^{a}
Different superscripts among the mean values are differed significantly from each other. P-value= 0.4470	

Table 3.10 Effect of *Acacia nilotica* on relative weight of proventriculus (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	0.41±0.01a
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.45±0.01a
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.40±0.01a
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.43±0.01a
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	0.42±0.01a
P-value= 0.1471	

3.11 Fat pad (%): Results on the effect of *Acacia nilotica* on fat pad (%) of broiler chickens is presented in Table 3.11. Fat pad (%) of broiler chicken was affected by different amount of *Acacia nilotica* supplementation. The significantly ($p<0.05$) lower fat pad (34.96±1.95%) was noted in T12, where the birds were supplemented with 12% *Acacia nilotica* along with a 100 mg/kg enzyme complex, compared to T9 (37.36±2.01%), T6 (40.08±2.43%), and T3 (41.39±2.27%), respectively. These groups received supplementation with 9%, 6% and 3% *Acacia nilotica*, respectively, along with the same 100 mg/kg enzyme complex. While, the fat pad (44.11±1.91%) were recorded higher in T0 group (control).

Table 4.11 Effect of *Acacia nilotica* on fat pad (%) of broiler chicken

Treatments	Mean±SE
T0 (Control)	$44.11±1.91^{a}$
T3 (3% *Acacia Nilotica* Pod + 100 g/kg enzyme)	$41.39±2.27^{ab}$
T6 (6% *Acacia Nilotica* Pod + 100 g/kg enzyme)	$40.08±2.43^{ab}$
T9 (9% *Acacia Nilotica* Pod + 100 g/kg enzyme)	$37.36±2.01^{ab}$
T12 (12% *Acacia Nilotica* Pod + 100 g/kg enzyme)	$34.96±1.95^{b}$
Different superscripts among the mean values are differed significantly from each other. P-value= 0.0492	

3.11 Economics: The economic results of the experiment are presented in Table 3.11, providing insights into the net returns obtained from each treatment group. The data reveals that the control group (T0) yielded the highest net return of Rs. 104.5 per chick. Following closely, the T3 group showed a net return of Rs. 100.9 per chick, indicating a relatively profitable outcome. However, the net returns gradually decreased for the subsequent treatment groups, with T6 generating Rs. 91 per chick, T9 generating Rs. 27.1 per chick, and T12 yielding Rs. 30.7 per chick.

Table 4.11 Economics

Particulars	T0	T3	T6	T9	T12
Day-old chicks (Rs/b)	45	45	45	45	45
Feed consumed (kg)	4.0	3.88	3.83	3.96	3.52
Rate of feed / kg	90	90	90	90	90
Feed cost (Rs)	360	349.2	344.7	356.4	316.8
Acacia nilotica Pod (Rs)	0	09	18	27	36
Medication / Vaccination (Rs)	12	12	12	12	12
Labour cost (Rs)	12	12	12	12	12
Misc. (Rs)	20	20	20	20	20
Total cost (Rs)	449	447.2	451.7	472.4	441.8
Final LBW (kg)	2.05	2.03	2.01	1.85	1.75
Marketing price (Rs)	270	270	270	270	270
Total Income Rs	553.5	548.1	542.7	499.5	472.5
Net profit (Rs)	**104.5**	**100.9**	**91**	**27.1**	**30.7**

4.0 Discussions

The results indicate that *Acacia nilotica* supplementation at levels of 3%, 6% and 9% significantly improved the growth performance of broiler chickens. However, a higher supplementation level of 12% negatively impacted the growth performance of broiler chicken. Results are in accordance with Oyeyinka et al. (2019) investigated the effect of dietary supplementation with Acacia nilotica leaf meal on broiler growth performance and carcass characteristics. The study revealed that broilers receiving Acacia nilotica leaf meal had higher body weight gain, improved feed efficiency, and favorable carcass traits compared to the control group. Gopalakrishnan et al. (2018) evaluated the impact of dietary supplementation with Acacia catechu extract on broiler performance, gut health, and immune response. The results showed that broilers supplemented with Acacia catechu extract exhibited improved growth performance, enhanced gut morphology, and strengthened immune function compared to the control group. Alabi et al. (2017) investigated the effects of aqueous Acacia nilotica leaf extracts on broiler performance. The study found that broilers supplemented with 120 mL/L of leaf extract had higher average daily body weight gain and final body weight compared to the control group. Feed intake was highest in the positive control group (receiving antibiotics) and lowest in the group consuming 90 mL/L of leaf extract. Additionally, birds fed with 90 mL/L and 120 mL/L of leaf extract had lower feed conversion ratios (FCR), indicating improved nutrient utilization. Hussein et al. (2018) investigated the effects of dietary supplementation with Moringa oleifera leaf powder on broiler performance. The study found that broilers fed diets containing Moringa leaf powder had significantly higher body weight gain, improved feed conversion ratio, and enhanced carcass characteristics compared to the control group. Abdel-Wareth et al. (2019) studied the impact of dietary supplementation with different levels of Moringa oleifera leaf meal on broiler performance and meat quality. The results indicated that broilers receiving Moringa leaf meal had improved growth performance, increased carcass yield, and better meat quality attributes compared to the control group. Ahmed et al. (2016) conducted a study to evaluate the effects of dietary supplementation with Moringa oleifera leaf extract on broiler performance and immune response. The findings demonstrated that broilers fed diets supplemented with Moringa leaf extract showed improved growth performance, enhanced immune parameters, and increased resistance to certain infections. Khan et al. (2017) conducted a study using moringa leaf powder as a dietary supplement at 1.2% levels in broilers. The results showed that broilers supplemented with moringa leaf powder had higher body weight compared to the control group, indicating improved growth performance. Abdulsalam et al. (2015) investigated the effects of moringa leaf meal supplementation in broilers during the finisher period. The study demonstrated that supplemented diets enhanced growth performance in terms of body weight gain. Oyeyinka & Oyeyinka (2018) studied the effects of dietary supplementation of Acacia nilotica leaves at 5% to 20% levels in broilers. The findings revealed that higher levels of supplementation resulted in improved growth performance in broilers. David et al. (2012) conducted a study using Acacia nilotica leaf powder as a feed additive in broilers. The results showed that broilers fed with Acacia nilotica leaf powder had improved live weight, body weight gain, dressing percentage, and feed conversion ratio. Hussein et al. (2018) investigated the effects of dietary supplementation with Moringa oleifera leaf powder in broilers. The study found that broilers supplemented with Moringa leaf powder had higher body weight gain, improved feed conversion ratio, and enhanced carcass characteristics. Abdel-Wareth et al. (2019) studied the impact of dietary supplementation with different levels of Moringa oleifera leaf meal on broiler performance and meat quality. The findings indicated that broilers receiving Moringa leaf meal had improved growth performance, increased carcass yield, and better meat quality attributes. Ahmed et al. (2016) conducted a study on the effects of dietary supplementation with Moringa oleifera leaf extract on broiler performance and immune response. The results showed that broilers fed with Moringa leaf extract had improved growth performance, enhanced immune parameters, and increased resistance to certain infections. Oyeyinka et al. (2019) investigated the effect of dietary supplementation with Acacia nilotica leaf meal on broiler growth performance and carcass characteristics. The study revealed that broilers supplemented with Acacia nilotica leaf meal had higher body weight gain, improved feed efficiency, and favorable carcass traits. Gopalakrishnan et al. (2018) evaluated the impact of dietary supplementation with Acacia catechu extract on broiler performance, gut health, and immune response. The findings demonstrated that broilers supplemented with Acacia catechu extract exhibited improved growth performance, enhanced gut morphology, and strengthened immune function. Ghosh et al. (2019) conducted a study to evaluate the effects of dietary supplementation with Curcuma longa (turmeric) extract on broiler performance and meat quality. The results showed that broilers fed diets containing turmeric extract had improved body weight gain, feed efficiency, and meat quality attributes compared to the control group. Botsoglou et al. (2002) investigated the effects of dietary supplementation with oregano essential oil on broiler performance and oxidative stability of meat. The study found that broilers supplemented with oregano essential oil had improved body weight gain, feed conversion ratio, and reduced lipid oxidation in meat samples. Hernandez et al. (2017) evaluated the impact of dietary supplementation with grape seed extract on broiler performance and meat quality. The findings indicated that broilers receiving grape seed extract had improved growth performance, reduced oxidative stress, and enhanced meat quality characteristics compared to the control group. Jang et al. (2019) conducted a study to assess the effects of dietary supplementation with garlic powder on broiler performance and gut health. The results showed that broilers supplemented with garlic powder had improved body weight gain, feed conversion ratio, and gut morphology, as well as reduced pathogenic bacteria in the gut. Wang et al. (2016) investigated the effects of dietary supplementation with Astragalus polysaccharides on broiler performance and immune response. The study demonstrated that broilers supplemented with Astragalus polysaccharides had improved growth performance, enhanced immune parameters, and increased antibody production compared to the control group. Yang et al. (2018) studied the impact of dietary supplementation with green tea extract on broiler growth performance and meat quality. The findings revealed that broilers receiving green tea extract had improved body weight gain, feed conversion ratio, and meat quality attributes, including reduced drip loss and improved tenderness. Abdel-Wareth et al. (2017) evaluated the effects of dietary supplementation with fenugreek seed powder on broiler performance and carcass characteristics. The study found that broilers fed diets containing fenugreek seed powder had improved growth performance, increased carcass yield, and enhanced meat quality traits compared to the control group. Ghazalah, A. A. (2005) conducted a study to evaluate the effects of dietary supplementation with thyme and rosemary essential oils on broiler performance and carcass characteristics. The results showed that broilers fed diets containing thyme or rosemary essential oils had improved body weight gain, feed conversion ratio, and carcass characteristics compared to the control group. Kucukersan, S. et al. (2016) investigated the effects of dietary supplementation with black cumin (Nigella sativa) seed on broiler performance and meat quality. The study found that broilers supplemented with black cumin seed had improved growth performance, reduced oxidative stress, and enhanced meat quality attributes compared to the control group. Huang et al. (2020) conducted a study to assess the effects of dietary supplementation with ginseng extract on broiler performance and immune response. The findings indicated that broilers receiving ginseng extract had improved growth performance, enhanced immune parameters, and increased antioxidant capacity compared to the control group. Ramadan, M. F. et al. (2018) evaluated the impact of dietary supplementation with fenugreek (Trigonella foenum-graecum) seeds on broiler performance and meat quality. The study demonstrated that broilers supplemented with fenugreek seeds had improved growth performance, reduced oxidative stress, and enhanced meat quality attributes compared to the control group. Hossain et al. (2015) studied the effects of dietary supplementation with neem (Azadirachta indica) leaf meal on broiler performance and immune response. The results showed that broilers supplemented with neem leaf meal had improved growth performance, enhanced immune parameters, and increased antibody production compared to the control group. Habibian et al. (2014) conducted a study to assess the effects of dietary supplementation with licorice (Glycyrrhiza glabra) root extract on broiler performance and gut health. The findings indicated that broilers receiving licorice root extract had improved growth performance, enhanced gut morphology, and reduced pathogenic bacteria in the gut compared to the control group. El-Deep et al. (2019) evaluated the impact of dietary supplementation with turmeric (Curcuma longa) powder on broiler performance and immune response. The study found that broilers supplemented with turmeric powder had improved growth performance, enhanced immune parameters, and increased antioxidant activity compared to the control group.

Findings of present study indicates that higher level Acacia nilotica (12%) supplementation reduced more fat pad % compared to low levels (9%, 6% and 3%). Similar kind of results supported by Ngambi et al. (2009) they stated that Acacia karroo leaf meal supplementation had an effect on fat pad weights of broiler chickens. Supplementation with 9 and 12 g of Acacia karroo leaf meal per kg DM of feed reduced fat pad weights in male broiler chickens by 26 and 29% points, respectively. Similarly, supplementation with 9 and 12 g of Acacia karroo leaf meal per kg DM feed reduced fat pad weights in female chickens by 26% points. These reductions were achieved without any significant reduction in feed intake and or digestibility. The physiological explanation for this effect is not clear and it, thus, merits further investigation. However, it is known that A. karroo leaves contain high contents of condensed tannins which tend to bind with feed and endogenous proteins and other nutrients, thus lowering diet intake and digestibility (Makkar, 2003). The presence of condensed tannins has been associated with reduced carcass fat in ruminant animals (Purchase and Keogh, 1984; Terril et al., 1992). However, no physiological explanations were given in their studies. No similar studies in chickens were found.

Conclusions

It can be concluded that Acacia nilotica supplementation has both positive and negative effects on the growth performance of broiler chickens. Lower levels of supplementation (3% and 6%) showed beneficial effects on weight gain, feed intake, feed efficiency, carcass weight, and dressing percentage. However, higher levels of supplementation (9% and 12%) had adverse effects on these parameters.

To optimize the use of Acacia nilotica supplementation in broiler chicken diets, it is crucial to carefully consider the dosage. Further studies are needed to determine the optimal level of supplementation that maximizes growth performance and carcass characteristics without compromising feed efficiency. These findings contribute to our understanding of the potential benefits and limitations of Acacia nilotica supplementation in broiler production systems.

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