

Acacia Angustissimaleaf Meal Use as Alternative Protein Source in Broiler (*Gallus Gallus Domesticus*) Chicks Feed



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Abstract

Broiler is the cheap source of protein for human. However, high demand of broiler causing much pressure on poultry industry. This pressure is mostly due to feed requirement. This study is design to find the effect of *Acacia angustissima* leaves on growth performance, carcass weight and internal organ of broiler. Total 120 chickens are taken in this experiment. Three different treatments 5%, 10% and 15% feeds are given to broilers along with one control. Total 120 chicks were purchased and kept in 4 different groups with triplet. Every group contain 10 chickens. They were feed for 6 weeks, and their live weight and feed consumption was recorded on every Friday at 8am for each bird. At the end of experiment after 6 weeks, 4 chickens from each treatment were slaughter and their carcass weight and internal organs weight were calculated. It is observed that 5% treatment give 1551g average weight on 6th week however, 10% remains 1462.2g and 15% on 1452.8g. The control group could produce 1501g. The treatments for live weight, breast weight, hot carcass and drumstick remain significant ($p < 0.05$). The significant value for defeathered weight and thigh remained non-significant ($p < 0.05$). Weight of intestine, gizzard and liver remained significant ($p < 0.05$) and heart's weight ($p > 0.05$). On average the weight of each chicken remains 1551g per chicken and feed intake 1079g/week. It is observed from this experiment, 5% inclusion of *Acacia angustissima* is best for growth performance and feed intake.

Keywords: *Acacia angustissima*; Leaf meal; Internal organs; Carcass; Growth performance

Introduction

Broiler, a meat-type of poultry; that has the ability to grow fast and reach market weight faster than ruminants [1] has stirred up interest in many farmers, because it plays a significant role as animal protein source in human diets by supplying essential amino acids needed for growth, development, and repair of worn-out tissues. Changes in atmosphere and expanding human population is causing much pressure on food requirement, which lead to extraordinary challenges to overcome this high demand for nourishment, this also make the traditional protein hotspot "chicken" much expensive [2,3]. Feed has a major part in total cost in modern broiler production, accounting about 70% of the total production cost [4]. The increase in feed price may therefore imply in the increase in total production cost and thus decrease the profit margin of broiler industry. This may also increase the market price for customers. The use of conventional protein sources such as peanut cake, sesame seedcake, soybean meal, and fish meal might sometimes be limited in poultry feeding due to their unavailability and costly [5]. There is need to improve the

scientific knowledge for utilizing low cost and locally available agro-industrial by-products in poultry feed in order to reduce the feed cost. This approach involves compounding of feed in a way that all the required nutrients come from cheap alternative energy and protein sources. Recently, there has been a trend to use leaf meal in combination with other active ingredients to further improve the functional effects of green leaf on broiler. The search for such alternatives has been the focus of Animal Nutritionists for over a decade [6]. This may be beneficial in reducing the proportion of the conventional-expensive protein-rich feed ingredients in broiler rations. It has been known that some particular foliage contains a number of bioactive compounds that are beneficial for the health of chickens [7]. Be that as it may, there are some roughage wellsprings of high nourishing evaluations especially in protein and micronutrient (nutrients promotion minerals) which could be tried as protein supplements for poultry. *Acacia angustissima*, a vegetable scavenge, has been the enthusiasm of numerous poultry researchers to use as feed for poultry [8], suggested that the

alternative plant protein should have comparative nutritive value to or preferably be cheaper than the conventional protein sources. This legume could be remembered for poultry abstains from food as a protein source, which would extraordinarily diminish the extent of soybean meal. Worthiness is impacted by appearance, immovability, deliciousness, delicacy and the kind of the meat. Shading, marbling and water holding limit, thusly, impacts the presence of meat. Newness, flavor, security and delicacy are probably the most significant meat qualities buyers search for [9].

Aims and Objectives

Check the affect of different inclusion levels of leaf meal on growth performance of chicks. To examine the effect of meal on internal organs and carcass yields

Materials and Method

The leaves have been accumulated from Mianwali located on north–east side of Pakistan range from 17°35'S to 31°14'E. Fresh tree appendages cut off creating centers at period of advancement. These were accumulated by means of circumspectly drubbing twigs with a reefer. These leaves were air-dried for 5 d in a shade to safe the breakdown of supplement. The dried leaves were then ground by passing them through 1mm sieve using a hammer mill. The powder *A.angustissima* was then embodied in diets at 0%, 5%, 10% and 15% of the overall weight of the diets [10].With the exception of *Acacia angustissima*, all the other ingredients used in this research were purchased from the open market in Mianwali. University of Lahore Sargodha Campus was selected for this research that is located in Punjab area. The site gets a normal precipitation that ranges somewhere between 410 and 500 m/annum. Average summer and winter temperature remains around 28 and 17°C, separately. Aggregate of one-day-old 120 chicks were purchased from National Chicks Farm Mianwali, then raised in cages. Grill chicks with a mean load of $41,7 \pm 1,51$ g were disseminated arbitrarily for 12 gatherings of 10 broiler creatures. The cages were distributed randomly for the three diets and were repeated three times in a random configuration and environmental temperature would be kept at 35 °C. The thermometer (in every cage or section of a cage) would be used to measuring the temperature. The temperature was controlled by heat lamp that was fitted above 18 inches in cage. Wood shavings were spread on the floor to serve as litter for the birds. To ensure a clean bedding material at all times, the wood shavings were changed at fortnightly interval. Each bird had an average floor space of 1.3sq ft. Lighting was done by electricity bulb and the birds had light throughout the night after the brooding period. Chick diets were made of iso-caloric and iso-nitrogenic 3 ingredients of wheat bran, rice and maize to fulfill the nutritional needs of the chicks. This control diet is formulated using soya bean, corn gluten, corn and oats grind all these ingredients in the shape of granules. *A.angustissima* leaves were compounded at 0, 05, 10 and 15 per

cent dietary levels after grinding. Feed blender was then used to mix the feed with each diet detailed with the crude materials. After mixing whole ingredients in balance amount add binder (vegetable oil) and water to bind ingredients. All data collected from this experiment was analyzed through a two-way analysis of variance the (ANOVA) test.

Result

Results of average live weight of chickens taken in different weeks are presented in (Table 1). It shows that all the different treatments are significantly different from each other. Increase in inclusion percentage of *Acacia angustissima* cause reduction in weight. In 10% and 15% inclusion, it is observed that average weight reduction starts from 3rd week of experiment and lasts till end. However, 5% treatment remains best throughout experiment and gives excellent results with 1551.001g average weight (Table 2), shows the effect of increasing percentages of *Acaciaangustissima* on growth performance parameters live weight, slaughter weight, fasted weight, defeathered weight, hot carcass, wings, back, drumstick bone, drum stick flesh, breast bone, breast flesh, thigh and chest. Out of all of these parameters, a decrease in average weights of Hot carcass, wings, back, drumstick bone, drumstick flesh and flesh were observed ($p<0.05$) with increase in *Acaciaangustissima* percentage. However, the significant value for live weight, slaughter weight fasted weight and defeathered weight remain greater than 0.9 ($P>0.05$). All the growth parameter observed in this study show a decreasing response toward increase in *Acaciaangustissima* percentage. The 5% *Acaciaangustissima* was found to be best out of all other (Table 3), shows a relation between different percentages of *Acaciaangustissima* in feed and mean weight of internal body parts intestine, gizzard, heart and liver. T2 treatment liver and proventriculus has almost same results with 10% and 15% inclusions. However, Gizzard of 5 10 and 15 % inclusion gave maximum weight for all compared to Control, studied in our experiment. It is observed that increasing percentage of *Acaciaangustissima* has a positive relationship with gizzard and proventriculus ($P<0.05$). However, there is no significant relation observed for heart weight ($P>0.05$). The optimum inclusion level for *Acaciaangustissima* is 5% because it has best results for all these parameters out of other inclusions (Table 4), shows the average weight of each chicken in every week, total feed consumption and feed consumption of one chicken in one week. This (Table 5) shows data of total 120 chickens. Feed consumption and weight obtained by feed consumption could be calculated. Feed consumption per each chicken can also be calculated and total estimated cost is lesser than feeds available in market. The 5% inclusions had best results for live body weight, consumable internal organ and carcass weight moreover, it is also economically better than market feeds because of price and availability.

Table 1: Ingredients and chemical composition of the diets.

Ingredients	T1	T2	T3	T4
Soya Bean	36	31	25	25
Leaf Meal	0	5	10	15
Corn Gluten	35	35	35	10
1Premix general	0.6	0.6	0.6	0.6
Corn	14	14	14	14
Oats	14	13	13.89	14
Vegetable Oil	0	1	1	1
Total	100	100	100	100
Chemical composition				
% DM	90	91	90.6	89.9
% CP	23.6	23.53	23.5	23.9
%E.E	3.68	3.9	5.19	4.16
Ash	5.77	6.1	6.99	4.77

Table 2: Effect of different treatments of *Acacia angustissima* live weight of broilers.

Week	T0	T1	T2	T3	S. E	Sig. Value
0	41.723	43.272	42.324	42.105	19.68	P<0.05
1 st	170.578	169.638	169.58	169.2		
2 nd	367	371.1	364.4	361.449		
3 rd	643.1	656.988	642.8	642.999		
4 th	811.174 ^a	825.969 ^a	783.300 ^b	773.567 ^b		
5 th	1091.085 ^b	1131.014 ^a	1059.700 ^c	1053.067 ^c		
6 th	1501.900 ^a	1551.000 ^a	1462.200 ^b	1452.800 ^b		

a and b and c indicate significantly different values (P>0.05), SE= standard error, T0, T1, T2 and T3= various treatments.

Table 3: Effect of different treatments of *Acacia angustissima* on different carcass parts.

Body characters	T0	T1	T2	T3	Sig. Value
Live weight(g)	1447.2500 ^b	1574.7500 ^a	1421.2500 ^b	-	
Slaughter weight	1291.0000 ^b	1398.7500 ^a	1236.2500 ^c	1367.0000 ^{ab}	
Fasted weight (g)	1359.7500 ^b	1473.7500 ^a	1330.7500 ^b	1396.2500 ^{ab}	
De-feathered weight	1212.7500 ^c	1349.7500 ^a	1185.0000 ^c	1265.0000 ^b	
Hot Carcass	1104.7500 ^{bc}	1232.2500 ^a	1086.5000 ^c	1169.2500 ^b	
Wings	73.2500 ^{ab}	71.7500 ^b	75.7500 ^a	73.5000 ^{ab}	
Back P>0.05	218.7500 ^a	216.5000 ^a	210.7500 ^a	181.2500 ^b	
Drum stick bone	211.0000 ^a	219.0000 ^a	207.7500 ^{ab}	202.5000 ^b	
Drum stick flesh	142.2500 ^b	150.5000 ^b	127.7500 ^c	187.7500 ^a	
Breast bone	98.5000 ^c	146.5000 ^a	111.2500 ^b	136.0000 ^a	
Breast flesh	117.5000 ^c	152.2500 ^a	145.0000 ^a	127.7500 ^b	
Chest	193.5000 ^b	203.5000 ^{ab}	208.5000 ^{ab}	214.2500 ^a	

a, b and c indicate significantly different values (P>0.05), SE= standard error, T0, T1, T2 and T3= various treatments.

Table 4: Effect of *Acaciaangustissima* treatment on internal organ.

Treatment	Liver	Heart	Gizzard	Spleen	Proventriculus	Sig. Value
T0	43.25	10.05	25.250 ^b	2.8	8.350 ^c	P<0.05
T1	43.1	9.9	27.275 ^a	2.7	9.500 ^b	
T2	42.75	9.975	27.975 ^a	2.65	10.250 ^{ab}	
T3	42	9.875	28.375 ^a	2.575	10.725 ^a	
S. E	0.47					

a, b and c indicate significantly different values (P>0.05), SE= standard error, T0, T1, T2 and T3= various treatments.

Table 5: Average feed consumption of chicken.

Treatments	1 st	2 nd	3 rd	4 th	5 th	6 th	Sig. Value
T0	2.9 ^a	2.4 ^a	1.8	1.8 ^a	1.8 ^a	1.6 ^a	P<0.05
T1	2.3 ^b	2.1 ^b	1.8	1.68 ^b	1.77 ^a	1.55 ^a	
T2	2.3 ^b	2.1 ^b	1.8	1.9 ^a	1.6 ^b	1.4 ^b	
T3	1.77 ^c	2.2 ^{ab}	1.8	1.9 ^a	1.7 ^{ab}	1.5 ^{ab}	

a, b and c indicate significantly different values (P>0.05), T0, T1, T2 and T3= various treatments.

Discussion

Broiler is the only cheapest source of protein for human [11]. Its high demand causes much pressure on poultry industry especially on its feed [12]. Therefore, much of research is going on it to find any cheap and easily available feed. This experiment is design to know the effect of *Acaciaangustissima* on growth performance of broiler and best percentage to be used in feet. In this research three different treatments were used to find the effect of *Acaciaangustissima* on broiler's body weight, carcass weight and internal organ. Three replicates 5%, 10% and 15% of *Acaciaangustissima* were used. First two weeks of development in broiler are called starter phase and believed that the digestive system during this starter phase remain immature. So, none of feed treatment work during this developmental phase and body weight remain same in all the treatments [13]. Taylor and Spring stated that after two weeks of captivity, broiler's digestive system become mature and start digesting all the feed. So different treatment starts working and gives different results for different percentages of treatment [14]. In our study growth performance of broiler's that were treated with different percentages of *Acaciaangustissima* remain same in first two weeks. The 10% and 15% used feed cause reduction in growth performance of birds. The 5% treatment gave best results for growth performance. Growth rate in any organism depends on feed intake [15]. Reduction in growth performance on increasing the inclusion of *Acaciaangustissima* is because of higher percentage of fibers in feed. These fibers are non-digestible, cause reduction in digestion of feed and remain no space for further feed. This cause lower in growth performance. The 5% inclusion had adequate percentage of fibers and cause better digestion in digestive system. As a little percentage is required for improving the digestive system's functionality. So, 5% inclusions gave best results for growth performance.

Onyimonyi et al (2009) described that *Acaciaangustissima* had high percentage of fibers that are not so easily digestible and cause imbalance of nutrients and improper digestion of fee in broiler. Lower digestion of nutrients cause reduction in energy production and disturbance in metabolism in gut. This reduction in total energy production and metabolism reduces the growth performance of birds. A similar explanation is also given by another researcher [16]. Leaves of Acacia contain a large amount of condensed tannins. During feed formation these condensed tannins bind to feed protein and nutrients. These condensed tannins are non-digestible, so inefficient digestion of protein and nutrients occur and cause lowering of diet intake [17]. The reduction of carcass fat due to the tannins was observed in ruminants [18]. However, there is no confirmed explanation for these results and no such study in chicken. [19] also observed an increase in growth performance; feed intake and carcass weight with 5% inclusion, however, further increase of *Acaciaangustissima* in feed cause decrease in growth performance along with feed intake and carcass weight. They further stated that *Acaciaangustissima* is a good source of protein and can be used as a feed source for broilers. It is a cheaper source and easily available. One opposite statement was given by Ngambi. They stated that Acacia had no effect on growth performance however cause reduction in fat from pad area [20,21], observed reduction in live weight of broiler from 0 to 9% inclusion of *Acaciaangustissima*. These live weight results were opposite to our results, in our study live weight and carcass weight increase up to 5% inclusion however, these may be because they added some inclusion of tartaric acid along with *Acaciaangustissima* in feed. Moreover, they stated that increase in *Acaciaangustissima* percentage up to 6% in broiler's feed cause increase in weight of gible and length of digestive tract, however, decrease in digestive tract weight. They didn't find any significant effect on carcass weight. We found an increase in carcass weight up to 5% addition

of *Acaciaangustissima*, further increase of *Acaciaangustissima* cause reduction in carcass weight. These results are consistent with [22]. This decrease in carcass weight with higher inclusion of *Acacia angustissima* is because of poor and inefficient digestion of nutrients. Insufficient digestion causes poor energy production [23]. This decrease in protein digestion, consumption of nutrients and energy production cause reduction in muscle development and reduced the weight of carcass [20], performed an experiment on broiler with *Acacia* in their feed. They find that increase in *Acacia* in feed didn't have any effect on feed intake and carcass weight. Only 9 to 12g supplementation of *Acacia* in feed reduced the fat weight on pad. This may be the reason of weight loss in broiler's that had *Acacia* in their feed in higher percentages in our study. They concluded that 6% inclusion of *Acaciaangustissima* with or without addition of tartaric acid, improve the overall economic efficiency of feed. High weight reported to be increased with increase in *Acaciaangustissima* in feed cause gradual reduction in thigh weight. This increase in thigh's weight is because of reduced weight of carcass [24], stated that increase in weight of body parts that are related to locomotion is related to decrease in weight of carcass. This increase in weight is also associated with breast. These organs develop earlier than any other body part to most of nutrients are taken by these organs. Reduction in weight of breast and thigh with 10 or 15% inclusion is because of inefficient nutrients [25]. The trend of weight of carcass parts was similar to live body weight in our study. Similar findings were also reported in broiler by [26]. The feed with 5% inclusions gave best result for weight of carcass part. All the groups with 5%, 10% and 15% were significantly different from each other's. The reasons for reduction in weight of carcass parts with increase in *Acaciaangustissima* level in feed was for two reasons, may be due to low feed intake or poor digestion of fibers [26]. Mostly, measurement of internal organ's weight is used to find the effect of toxic substances in feed in animals. In our results, weight of all organ (Intestine, Gizzard, Liver and Heart) is reported to be highest at 5% inclusion of *Acaciaangustissima*. Higher level of *Acacia angustissima* cause digestion problem to animals and give lower nutrition values. Birds with strong gizzard can perform well in digesting fibers of *Acaciaangustissima*. An increase in heart weight can be explained by high availability of blood and nutrition. An increase in heart weight of broiler is reported when *Moringaoleifera* leaf are used in feed [27].

Conclusion

This study concluded that 5% inclusion of *Acacia angustissima* in chicken feed give best results on growth performance, carcass yields and internal organs of broiler chicken. This inclusion also gave better weight increase than other treatments.

References

- Madubuike FN, BU Ekenyem (2001) Non-ruminant Livestock Production in the Tropics. Gust Chuks Graphics, Owerri, Nigeria, Pp. 185.
- Melesse A, Getye Y, Berihun K, Banerjee S (2013) Effect of feeding graded levels of *Moringa stenopetala* leaf meal on growth performance, carcass traits and some serum biochemical parameters of Koekoek chickens. *Livest. Sci* 157: 498-505.
- Mpofu DA, Marume U, Mlambo V, Hugo A (2016) The effects of *Lippia javanica* dietary inclusion on growth performance, carcass characteristics and fatty acid profiles of broiler chickens. *Animal Nutrition* 2(3): 160-167.
- Sugiharto S (2019) A review on fungal fermented cassava pulp as a cheap alternative feedstuff in poultry ration. *Journal of World's Poultry Research* 9: 01-06.
- Etalem Tesfaye, Getachew Animut, Mengistu Urge, Tadelle Dessie (2013) *Moringa olifera* Leaf Meal as an Alternative Protein Feed Ingredient in Broiler Ration. *International Journal of Poultry Science* 12(5): 289-297.
- Onyimonyi AE, JO Onukwufor (2003) Effect of toasted Bambara (*Voandzeia subterrenea* Thouars) waste on Performance of growing pullets. *Proc. 28th Ann. Conf. Nig. Soc. For Anim. Prod. (NSAP)*, Pp. 237-239.
- Rama Rao SV, Raju MVLN, Prakash B, Rajkumar U, Reddy EPK (2019) Effect of supplementing moringa (*Moringa oleifera*) leaf meal and pomegranate (*Punica granatum*) peel meal on performance, carcass attributes, immune and antioxidant responses in broiler chickens. *Animal Production Science* 59: 288-294.
- Atteh JO, FD Ologbenla (1993) Replacement of Fishmeal with maggots in Broiler diets Effects on performance and nutrient retention. *Nig. J. Anim. Prod* 20: 40-50.
- Vermeulen H, Schönfeldt Hc, Pretorius B (2015) A consumer perspective of the South African red meat classification system. *South African Journal of Animal Science* 45(3): 341-352.
- Ncube S, Hamudikuwanda H, Banda P (2012) The Potential of *Acacia angustissima* Leaf Meal as a Supplementary Feed Source in Broiler Finisher Diets. *International Journal of Poultry Science* 11: 55-60.
- Biswas SS, Mostafa M, Saha SS (2020) Effects of Neem Tulsi and Ginger Extract as a Growth Promoter in Broilers Production. *Int. J. Curr. Microbiol. App. Sci* 9(3): 1331-1339.
- Khan AZ, Kumbhar S, Liu Y, Hamid M, Pan C, et al. (2018) Dietary supplementation of selenium-enriched probiotics enhances meat quality of broiler chickens (*Gallus gallus domesticus*) raised under high ambient temperature. *Biological trace element research* 182(2): 328-338.
- Mbajiorgu CA, Ng'Ambi JW, Norris DD (2011) Voluntary feed intake and nutrient composition in chickens. *Asian Journal of Animal and Veterinary Advances* 6(1): 20-28.
- Taylor Pickard JA, Spring P (2008). *Gut efficiency; the key ingredient in pig and poultry production: elevating animal performance and health.* Wageningen Academic Publishers.
- Scott TA (2005) Variation in feed intake of broiler chickens. *Recent Advances in Animal Nutrition in Australia* 15: 237-244.
- Svihus B, Sacranie A, Denstadli V, Choct M (2010) Nutrient utilization and functionality of the anterior digestive tract caused by intermittent feeding and inclusion of whole wheat in diets for broiler chickens. *Poultry science* 89(12): 2617-2625.
- Makkar HPS (2003) Effects and fate of tannins in ruminant animals, adaptation to tannins, and strategies to overcome detrimental effects of feeding tannin-rich feeds. *Small ruminant research* 49(3): 241-256.
- Terril TH, Douglas GB, Foote AG, Purchas RW, Wilson GF (1992) Effect of condensed tannins upon body growth, wool growth and rumen metabolism in sheep grazing sulla (*Hedysarum coronarium*) and perennial pasture. *J Agric Sci* 119: 265-273.

19. Gudiso XC, Hlatini VA, Chimonyo M, Mafongoya PL (2018) Response of broiler (*Gallus gallus domesticus*) performance and carcass traits to increasing levels of *Acacia angustissima* leaf meal as a partial replacement of standard protein sources. *J Appl Poult Res* 28(1): 13-22.
20. Ng'ambi JW, Nakalebe PM, Norris D, Malatje MS, Mbajiorgu CA (2009) Effects of dietary energy level and tanniferous *Acacia* karroo leaf meal level of supplementation at finisher stage on performance and carcass characteristics of Ross 308 broiler chickens in South Africa. *International Journal of Poultry Science* 8(1): 40-46.
21. El Galil A, Hassan MM, Abu El Soud KM, El Dayem A, Salem FM (2019) Utilization of *Acacia Saligna* Leaf Meal As A Non-Traditional Feedstuff By Local Growing Hens Under Desert Conditions. *Egyptian Journal of Nutrition and Feeds* 22(1): 211-217.
22. Gadzirayi CT, Masamha B, Mupangwa JF, Washaya S (2012) Performance of broiler chickens fed on mature *Moringa oleifera* leaf meal as a protein supplement to soyabean meal. *International Journal of Poultry Science* 11(1): 5-10.
23. McSweeney CS, Collins EMC, Blackall LL, Seawright AA (2008) A review of anti-nutritive factors limiting potential use of *Acacia angustissima* as a ruminant feed. *Animal feed science and technology* 147(1-3): 158-171.
24. Faria PB, Bressan MC, De Souza XR, Rossato LV, Botega LMG, et al. (2010) Carcass and parts yield of broilers reared under a semi-extensive system. *Brazilian Journal of Poultry Science* 12(3): 153-159.
25. Relandeau C, Le Bellego L (2004) Amino acid nutrition of broiler chicken update on lysine, threonine and other amino acids. *Ajinomoto Eurolysine Information* 27: 1-36.
26. Nwoche GN, Ndubuisi EC, Iheukwumere FC (2006) Performance of finisher broilers and cost implication of feeding palm oil as energy supplement. *Nigeria Agricultural Journal* 37: 44-49.
27. Nkukwana TT, Muchenje V, Pieterse E, Masika PJ, Mabusela TP, et al. (2014) Effect of *Moringa oleifera* leaf meal on growth performance, apparent digestibility, digestive organ size and carcass yield in broiler chickens. *Livestock Science* 161: 139-146.



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