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Original article

***Acacia saligna* seed meal as alternative feed ingredient in broiler ration: Effect on productive performance and carcass characteristics**

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ABSTRACT

The experiment was conducted to determine the productive performances and carcass characteristics of broilers fed graded raw *Acacia saligna* seed meal. A total of 132 Cobb500 unsexed day-old broiler chicken were used for the experiment. The chicks were randomly allocated to four dietary treatments containing 0%, 5%, 10% and 15% *A. saligna* seed meal. A completely randomized design (CRD) with three replications was used and 33 chicks were allocated for each treatment. The daily dry matter intake showed significant difference ($P < 0.05$) among treatments in the starter, finisher and entire period which was higher in chicks fed T2 (66.03 g/chick) and T1 (65.02 g/chick) but lowest for T3 (40.73 g/chick) and T4 (45.54 g/chick) in the entire period. Similarly, the feed conversion ratio (FCR) in the starter, finisher and overall experimental period; final body weight, body weight change and daily weight gain in the starter phase showed significant ($P < 0.05$) difference among treatments. The highest FCR was recorded for T3 (0.35) while the lowest was for T2 (0.25). However, there was no significant difference ($P > 0.05$) among treatments in the daily weight gain, final body weight, body weight change and carcass parameters in finisher and entire period. Therefore, it can be concluded that raw *A. saligna* seed meal can be incorporated up to 5% level in the diet of broilers for better growth performance and carcass characteristics.

1. Introduction

In Ethiopia, the main feed sources for the village chicken is, scavenging which includes house wastes, cereals and their by-products, pulses, roots and tubers, oilseeds and shrubs (Tadelle, 1996). According to Solomon (1996), cereal grain production, which constitutes the poultry feed is very poor. There are shortages of protein and micro-nutrient supplement that are very important ingredients in poultry ration which leads in low production and productivity. The main reason for low productivity of poultry production in Ethiopia is the poor feeding system (Alemu, 1995; Alemu and Tadelle, 1997).

Feed cost accounts for two-third of the total cost of poultry production for egg and meat (James, 1992; Solomon, 2008). However, smallholder farmers and small scale producers from different corners of the country have limited access to formulated rations. Though, there are some poultry producers that can purchase formulated feed, its high cost and transportation expenditure challenged the development of the sector. The demand for animal protein sources is increasing from time to time. Hence, to make cheap animal protein sources affordable for most people, poultry production cost should be minimized. Thus, it is necessary to formulate balanced poultry rations from locally available and non-conventional feed resources like *Acacia saligna* seed.

In Tigray region, *A. saligna* is a multipurpose, evergreen and drought resistant fodder tree which was introduced in the 1980s for environmental rehabilitation, soil and water conservation to gullies, and homesteads (personal communication). It is a tree that produces seeds twice per annum during drought and found in most enclosure areas in the region. It is the best ones that are promising, locally available and edible seed by poultry (Acacia Study Group News letter No. 98, 2007). The seeds also can be used as human food mixed with other food cereals like wheat and others (Maslin et al., 1998). According to Ee and Yates, (2012), whole wattle seeds comprised of (27.6-32.6%) proteins and (30.2-36.4%) carbohydrates which had 12-14% fat and 13-15% crude fiber. Its palmitic, stearic, oleic and linoleic acid contents were also 9.6 %, 2 %, 20 % and 64.3 %, respectively. The anti-nutritional content of the seeds were (0.2%) phenolic, (2.2-3.4%) oxalate and (2.6-3%) saponin which were fairly high but low phytate content. However, the seed was not utilized as chicken feed in the region. Therefore, this study was designed to evaluate the effect of feeding raw *A. saligna* seed meal on productive performances and carcass characteristics of chickens.

2. Materials and methods

2.1. Study area

The experiment was conducted at Mekelle University poultry farm, located 783 Km north of Addis Ababa, at an altitude of 2250 meters above sea level with 13^o28'N latitude and 39^o29'E longitude. The average annual rainfall is 680 mm and average maximum and minimum temperatures are 26.4 and 8.25°C, respectively.

2.2. Experimental ration and treatments

The feed ingredients were maize, *A. saligna* seed, wheat middling, noug cake (*G. abyssinica*), vitamin premix, salt, limestone, methionine and lysine. *A. saligna* seeds were collected from the surroundings of Mekelle city. The acacia seeds, maize and noug cake were grounded to pass 5 mm sieve size and sent for laboratory composition analysis which was used for ration formulation. Experimental treatments consisted of different levels of raw acacia seed including: control (C) or 0% acacia (T1), 95% C + 5% acacia (T2), 90 % C + 10% acacia (T3), and 85% C + 15% acacia (T4), were formulated to be nearly iso-caloric and iso-nitrogenous with Metabolizable Energy (ME) content of 12.97 MJ/kg DM and 22% CP for starter phase of 1 to 28 days of age and ME content of 13.39 MJ/kg DM and 19-20% CP for finisher phase of 29 to 49 was formulated using Win feed 2.8 software. The metabolizable energy (ME) of the experimental diets was determined by indirect methods, according to Wiseman, (1987) as follows: ME (Kcal/Kg DM) = 3951 + 54.4EE - 88.7CF - 40.8Ash.

Table 1

Diet composition of broilers (1-49) day age.

Ingredients	Starter dies (1-28 day age)				Finisher diet (29-49 day age)			
	T1	T2	T3	T4	T1	T2	T3	T4
Acacia seed	0	5	10	15	0	5	10	15
Wheat md	21.3	16.3	10.3	9.26	23.2	8.21	8.21	8.21
Nuge cake	38	38	37	34	30	33	31	30
Maize	37	37	39	38	44	51	48	44
Limestone	1.2	1.2	1.2	1.2	0.8	0.8	0.8	0.8
Salt	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Vitamin pre	1	1	1	1	0.7	0.7	0.7	0.7
Lysine	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6
Methionine	0.34	0.34	0.34	0.34	0.29	0.29	0.29	0.29
Total (Kg)	100	100	100	100	100	100	100	100
ME	12.97	12.98	13.00	13.09	13.67	13.57	13.54	13.42
CP %	22	22	22	22	19	19	19.8	19

T= treatment, kg= kilogram, ME= metabolizable energy (MJ/kg DM), MJ= Mega joule, CP= crude protein, DM = dry matter, md= middling, pre= premix.

2.3. Management of experimental animals

One hundred and thirty two unsexed day-old Cobb500 broiler chicks with initial body weight of 36.93 ± 0.38 g (mean \pm SD) were randomly divided into four dietary treatments with three replications per treatment in a completely randomized design having eleven chicks per pen with the size of 1m x 1.5m. The chicks were vaccinated against Newcastle (HB1 at day 7 with eye drop and Lasota with drinking water at day 21) and Infectious Bursal Disease (Gumboro) at the age of 14 days with drinking water. The house was disinfected with potassium permanganate and formaldehyde two months before the commencement of the experiment. Chicks were given an access to 250 watt heat, *ad libitum* feed and water in pen with deep litter covered by wheat straw.

2.4. Measurements

The amount of feed offered and refused per pen was recorded daily. Feed intake was determined as the difference between the feed offered and refused. Chicks were weighed weekly in a group per pen and pen average was calculated. Body Weight (BW) change was calculated as the difference between the final and initial BW. Average daily BW gain (ADG) was calculated as the ratio of BW change to the number of experimental days. Feed conversion ratio was computed as the ratio of ADG to daily DM consumption.

2.5. Carcass parameters and dressing percentage

For carcass parameters determination chicks were starved for 12 hrs prior to slaughtering procedures. A total of 3 Chicks were slaughtered from each treatment. Carcass weight measurements were done after de-feathering and removal of feet, head and non-edible viscera. Then hot carcass dressing percentage was calculated by dividing the hot carcass weight by the live body weight of the chicks.

2.6. Proximate analysis

Seed samples were analyzed for dry matter (DM), crude protein (CP), ether extract (EE), crude fiber (CF) and ash (AOAC, 2005). Phytate was determined using the method of Reddy and Love, (1999) and tannin was determined using the method of Trese and Evans, (1978).

2.7. Data analysis procedures

The collected data were analyzed using GMP5 software. One-way Analysis of variance (ANOVA) was used to compare the treatment means of the group and for existence of significant differences among treatments, the students t-test at $P < 0.05$ was used. The following model was used for the experiment (Gomez and Gomez, 1984)

$$Y_{ij} = \mu + T_i + e_{ij}$$

Where,

Y_{ij} = Overall Responses

μ = overall mean

T_i = i^{th} treatment effect of feeding level (1, 2,.... 10)

e_{ij} = random error effect

3. Results

3.1. Chemical composition of feed ingredients

The chemical compositions of feed ingredients used in the experiment are presented in Table 2. The result showed that there was similar DM content of ingredients while CP ranges from 7.43% of maize to 34% of nouge cake. The ME of raw *A. saligna* seed meal was lower compared to maize but higher EE and CF % than the other ingredients except nouge cake. The average tannin and phytate content of acacia seeds were 0.53 and 0.83 mg/g respectively.

Table 2

Proximate composition of experimental diets

S/N	Ingredients	DM (%)	CP (%)	EE (%)	CF (%)	NFE (%)	Ash (%)	ME	Tannin (mg/g)	phytate (mg/g)
1	Maize	89.74	7.43	5.09	2.79	83.19	1.5	16.40		
2	Nouge cake	91.94	34	7.09	21.93	27.9	9.08	8.45		
	Wheat									
3	Middling	86.76	15.17	3.26	3.69	74.83	3.05	15.38		
4	Raw acacia	90.83	28.16	15.51	14.43	36.8	5.1	13.83	0.53	0.83

DM= dry matter, CP= crude protein, EE= ether extract, CF= crude fiber, NFE= nitrogen free extract, ME= metabolizable energy (MJ/kg DM), mg= milligram, g= gram.

3.2. Dry matter intake and body weight change

The average DMI, BW change, daily gain and FCR performances of chicks are presented in Table 3. The DMI and FCR showed significant difference ($P < 0.05$) in the starter, finisher and entire experimental period. Similarly, there was a significant difference ($P < 0.05$) in final BW, BW change and daily gain among chicks in the starter phase, whereas, there was no significant difference ($P > 0.05$) in the finisher and entire experimental period.

Table 3

Average dry matter intake, body weight change, average daily gain and feed conversion efficiency performances of broilers fed *A. saligna* seed meal based diets.

Parameters	T1	T2	T3	T4	P<0.05
DMI (g/chick)					
Starter	39.15 ^a	39.75 ^a	32.76 ^b	31.32 ^b	0.007
Finisher	99.52 ^a	101.08 ^a	51.37 ^b	64.49 ^b	0.01
Entire period	65.02 ^a	66.03 ^a	40.73 ^b	45.54 ^b	0.003
IBW (g/chick)					
Day old	36.9	36.94	36.9	36.9	1.0
FBW (g/chick)					
Starter	403.00 ^a	373.60 ^a	306.70 ^b	311.67 ^b	0.005
Finisher	861.5	830.77	743.33	743.5	0.384
BWC (g/chick)					
Starter	366.10 ^a	336.66 ^a	269.80 ^b	274.77 ^b	0.005
Finisher	458.5	457.17	436.63	431.83	0.981

Entire period	824.6	793.82	706.43	706.6	0.384
ADG (g/chick)					
Starter	13.08 ^a	12.02 ^a	9.64 ^b	9.81 ^b	0.005
Finisher	21.83	21.77	20.79	20.56	0.384
Entire period	16.83	16.20	14.42	14.42	0.384
FCR					
Starter	0.33 ^a	0.30 ^{ab}	0.29 ^b	0.31 ^{ab}	0.01
Finisher	0.23 ^{bc}	0.22 ^c	0.39 ^a	0.32 ^{ab}	0.01
Entire period	0.26 ^{bc}	0.25 ^c	0.35 ^a	0.32 ^{ab}	0.025

Rows not connected by same letter are significantly different at P<0.05, DMI= dry matter intake, IBW= initial body weight, FBW= final body weight, BWC= body weight change, ADG= average daily gain, FCR= feed conversion ratio, T= treatment.

3.3. Carcass parameters of broilers

The results showed no significant variation (P>0.05) among treatments in the carcass characteristics.

Table 4

Carcass parameters of broilers fed raw and treated *A. saligna* seed meal based diets.

Parameters	Treatments				P<0.05
	T1	T2	T3	T4	
Live Wt.	814	997	783.67	877.33	NS
Head	32.33	34	27.67	33.67	NS
Feather	39.67	43.67	44.67	40.67	NS
Skin	46.67	62	44.67	58	NS
Neck	25.67	34.33	23.67	27.67	NS
Feet	53.33	51.33	41.67	46.33	NS
Wing	32.67	43	29.67	35.33	NS
Thigh	75.33	97.33	70.67	81.67	NS
Drumstick	74.67	94.33	70.67	81	NS
Breast	181	223.67	172.33	194.67	NS
Heart	8.33	8.33	6	6.67	NS
Liver	21.33	28	19.67	21	NS
Gizzard	19.33	21.33	18.67	21.67	NS
Tail	4.33	5	3.67	4.33	NS
Gut	41.33	47.67	40.67	44.33	NS
Blood	35	42	34.67	36.67	NS
Crop and pro-ventriculos	16.33	17.67	15.33	16.67	NS
Back	58.67	77.67	53.33	63.67	NS
Carcass wt.	448	570.33	420.33	484	NS
Adjust carcass wt.	543.67	690	509.33	591.33	NS
Dressing %	66.75	69.26	64.99	67.24	NS
Lost wt.	48	65.67	66	63.33	NS

4. Discussion

The result showed that the ME of raw *A. saligna* seed meal was low compared to maize; whereas, the CP, EE and CF % were high compared to maize and wheat middling. *A. saligna* seed has comparable CP content with nouge seed cake which indicates that it can be used as both energy and protein sources in poultry ration. The raw *A. saligna* seed had similar DM (90.4-93.6%), CP (27.8-32.6%), EE (12.8-15.7%) and CF (12.9-14.5%) content with the findings of (Ee and Yates, 2012). Besides, it has higher CF than maize and wheat middling, which limits the DM intake of the seed. The tannin was low compared to *A. colei* (86.7 mg/g), *A. tumida* (80.3 mg/g) while the phytate contents were higher than *A. colei* (0.09 mg/g) and *A. tumida* (0.03 mg/g) (Falade et al., 2005). However, the phytate content was similar with result of Ee and Yates, (2012).

The highest DDMI was recorded in chicks fed T2, and T1 while, the lowest was recorded by T3 and T4. This may indicate that there are anti-nutritional factors un-discovered that limit the intake of chicks in the diet. This finding was similar to the report of Obun et al., (2011), as the level of raw seed meal increases, the dry matter intake decreases and similarly, Duwa et al., (2012) and Onu and Okongwu, (2006) also reported that chicks fed raw *H. sabdariffa* and *C. cajan* seed meal perform better (69.45g/chick) and (55.48 g/chick) DDMI in the starter phase which was higher than this study result which might be due to variation in the palatability of the feed and breed of the chicks used. However, the DDMI in this study was comparable with report of Ayanwale et al., (2007), chicks fed *A. africana* seed meal performed (37.60- 41.85 g/chick) and Etalem et al., (2012), chicks fed cassava root chips, which perform (33.83-37.06 g/chick). In this phase, chicks fed acacia based diet; especially the 5% perform comparable DDMI with the control which implies that the seed can be alternatively used in the starter broiler ration.

In the finisher phase, the DDMI was highest in chicks fed T2 and T1 while the lowest was recorded in chicks fed T3 and T4. Chicks in the current study perform lower DDMI than chicks fed *H. sabdariffa* which perform (120.72-145.14 g/chick) (Duwa et al., 2012) while similar performance was observed in chicks fed 5% *A. saligna* seed meal and control with the findings of Etalem et al., (2012) in which chicks fed on cassava root chips based diet performed (85.58-96.01g/chick). This difference might be due to variation in the palatability of the feed and

In the entire experimental period, the overall mean DDMI was highest for chicks fed T2 and T1 while the lowest was recorded for chicks fed T3 and T4. The DDMI of the chicks was lower than the report of (94.78-105.26 g/chick) Duwa et al., (2012) while the chicks fed on T1 and T2 performed similar DDMI with chicks fed on cassava root chips (61.34-66.83 g/chick) Etalem et al., (2012). This was also in line with the findings of Onu and Okongwu, (2006), stated that the higher feed intake of chicks fed raw pigeon pea seed meal indicates that the chicks need to meet their nutrient requirement from diet containing anti-metabolites. Similarly, it was also in agreement with the study of (Obun et al., 2011) on feeding raw *D. microcarpum* seed meal and feeding raw jack bean based diets (Leon et al., 1991; Ologhobo et al., 1993), stating that as the level of raw seed meal in the ration increases, DMI decreases. The same argument can explain in this study for the decreased DMI with increasing inclusion level. With regard to the effect of tannin and phytate, the result of this study was below the maximum dietary tannin and phytate level which stated by Kumar et al., (2007), 16g/kg of dietary tannin had no effect on nitrogen, calcium and phosphorus retention. Similarly, Begovic et al., (1978) stated that the maximum dietary level that poultry can tolerate is 1%. A diet of 1 - 6% phytate over a long period reduced the bioavailability of mineral elements in monogastric animals (Oke, 1969).

In the starter phase, there was significant ($P<0.05$) difference among chicks fed T1/T2 and T3/T4 in the final body weight, weight change, ADG and FCR, whereas, there was no significant ($P>0.05$) difference among chicks fed T1 and T2 or T3 and T4. The highest FCR was observed in chicks fed T1 while the lowest was recorded in chicks fed T3. However, there was no significant ($P>0.05$) difference among chicks fed T1, T2 and T4 in FCR. Highest FCR implied that low amount of feed is required to obtain gram of body weight gain or the feed is nutritionally good, digestible and nutrient available. Whereas, small FCR indicated that high amount of feed is required to obtain gram of body weight gain.

This study was in line with Ayanwale et al., (2007), finding for broilers fed raw *A. africana* seed meal significantly reduced daily weight gain compared to the control in the starter phase. Broilers in this study performed lower DWG than the finding of Onu and Okongwu, (2006) (17.17 - 23.73 g/chick), Ayanwale et al., (2007) (19.66 - 20.63 g/chick) and Etalem et al., (2012) (15.62 - 17.03 g/chick). The poor performance of the chicks compared to other reports might be related to the effect of cool environmental temperature which was stated by Wideman (1988), feed form, anti-nutrient content, performance of the individual chicks and breed difference.

In the finisher phase, there was significant ($P<0.05$) difference on FCR but there was no significant ($P>0.05$) difference among all treatments in the FBW, BW change, and DWG. Whereas, there was significant ($P<0.05$) difference in FCR among chicks fed T1, T2, and T3 and T4, but there was no significant ($P>0.05$) difference among T3 and T4. The highest FCR was recorded by T3 whereas, the lowest was recorded by T2 and T1 (Table 3). This was similar with the findings of Onu and Okongwu, (2006) stated that, the increased dry matter intake of chicks which did not result in increased weight gain might be to fulfill the nutrient requirement of the chicks or might be related to ascites (Wideman, 1988). Similarly, according to Onu and Okongwu, (2006) the superior FCR of chicks suggested that there are enhanced availability, digestion, absorption and utilization of the nutrients in the diet.

During the entire experimental period, there was no significant ($P>0.05$) difference among treatments on FBW, BW change and DWG of chicks. However, there was significant ($P<0.05$) difference of the treatment effect on

the FCR. Hence, the highest FCR was observed in chicks fed T3 but the lowest was recorded by T2 and T1 (Table 3). This study agrees with Onu and Okongwu, (2006) and Wideman, (1988). However, it was not in agreement on the BWG studied by Obun et al., (2011) and Hassan et al., (2013). There was also no significant difference on the carcass characteristics of the chicken implying that it can be used as broiler feed without any adverse effect on the carcass of broilers. The study discovered that *A. saligna* seed meal is significant sources of crude protein and energy and thus it can be concluded that raw *A. saligna* seed meal can be incorporated up to 5% level in the diet of broilers.

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