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Effect of Feeding Graded Levels of *Adansonia digitata* (Tebaldi) Seed Cake on the Performance of Broiler Chicks

M. Y. Altaher[1,2], R. Malaka[3*], W. Pakiding[3], S. Purwanti[4], E. A. Amin[5], R. W. Kadir[2], and S. N. Waqiah[2]

1- Department of Poultry Production, Faculty of Agriculture, Omdurman Islamic University, Sudan
2- Postgraduate student of the Animal Science study program, Faculty of Animal Science, Hasanuddin University, Indonesia
3- Department of Animal Production, Faculty of Animal Science, Hasanuddin University, Indonesia
4- Department of Animal Nutrition, Faculty of Animal Science, Hasanuddin University, Indonesia
5- Department of Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Khartoum, Sudan
*Corresponding author- E-mail: malaka_ag39@yahoo.co.id , phone number (+249)92-444-8352

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ABSTRACT

The study was designed to determine the effects of feeding graded levels of *Adansonia digitata* (Tebaldi) seed cake on the performance of broiler chicks. One week old, two hundred unsexed broiler chicks of the Ross 308 strain were randomly allotted to four treatments in a 4x5x10 arrangement. Four experimental broiler rations, semi-isocaloric semi-isonitrogenous, were formulated with ascending levels of *A. digitata* seed cake replacing performed total crude protein content of the diet percentage-wise as 0, 5, 10, and 15% and designated as rations A, B, C, and D respectively with ration A serving as the control. Experimental feeding was continued for 42 days on an *ad-libitum* basis, allowing for an initial adaptation feeding period of one week. The first three days of this adaptation used the pre-starter ration, then four days on the control diet before feeding the experimental rations. Data collected included daily feed intake (g), body weight (g), calculated protein intake and efficiency, energy intake (Mcal ME /Kg), and feed conversion ratio. An economic appraisal was run for the experiment. The highest daily feed intake (106.30), live weight gain (60.50), improved feed conversion ratio (01.70), highest cold carcass weight (02.44), and dressing percentage (66.10) were recorded by group B (5% Tebaldi) compared to the other groups. Group C (10% Tebaldi) gave the highest profitability, 97.22%. *Adansonia digitata* seed cake can be fed to broiler chicks up to 10% of the ration without adverse effects on the performance and with maximized profitability ratios of 1.3 -1.7 over the control.

Keywords: *Adansonia digitata* seed cake, broiler chickens, feed conversion ratio, growth performance, carcass yield

INTRODUCTION

The poultry industry has been the most dynamic sector in the global meat business over the last decade [1], with significant growth reflected in rising global food demand. In most modern countries, including Sudan, the poultry industry accounts for a considerable share of the economy, providing a valuable source of protein with high biological value and yielding meat and eggs at lower total feed costs than other meats [1]. Consumer preferences have also changed in many developing countries, increasing demand for low–calorie, low-cholesterol foods [2]. Babieker [3] reported that cottonseed, ground nuts, sesame cakes, and wheat bran are considered the primary sources of crude protein for poultry in the Sudan. Because these ingredients are scarce and expensive, nutritionists sought alternative feedstuffs from new, non-conventional resources for poultry feeding. This also reduced competition between humans and animals for staple feed resources and proved cheaper than conventional resources [4] [5]. These sources include leaf meals, tree seed cakes, oil seed cakes, some legumes that produce protein, and other sources of vitamins, minerals, and amino acids that are not edible to humans but have been proven to be easily usable to reduce feed expenses and optimize profitability in poultry feed [6].

The Tebaldi tree (*Adansonia digitata* L., family Bombacaceae) is a large deciduous species that can grow to 25-30 meters in height. It is mainly found in Sudan, distributed across the central belt regions, including Kordofan, Darfur, Blue Nile, and Upper Nile. The tree produces an annual yield of Tebaldi fruit capsules, each filled with numerous hard, brownish seeds embedded in a yellowish-white, floury pulp [7].

The nutritional composition of baobab seed cake has been reported to very across studies [6] found and reported that the Tebaldi seed cake contain 15.1% CP and 2.22Mcal/kg Mcal on a dry matter basis in contrast, other researchers [8] [9] have indicated higher crude protein values ranging from 20% to 36%, Osman [10] and Nkafamiya [9] said Tebaldi seed cake has 3.0- 4.50 M cal ME/kg, Murray et al. [8] set it at1.90-4.47Mcal ME/kg suggesting that it nutrient composition may be influenced by factors such as processing methods, seed maturity and analytical procedures

Adansonia digitata seed cake contains anti-nutritional factors, including oxalates, phytates, saponins, and tannins [11]. Still, their levels are generally below the toxic levels for most livestock species, including poultry [8]. The seed kernels contain 12.15% edible oil. They are also rich in lysine, thiamine, calcium, and iron, but also provide some necessary fiber, vitamins, minerals, and amino acids, particularly lysine and methionine, which are limited in most cereals but essential for livestock growth and development of prime interest is the abundant vitamin C content of the Tebaldi [12] [13].

Adansonia digitata seed cake is a low–cost, locally available, non-conventional protein source for poultry diets [14]. Information on the nutritional value of Tebaldi tree seed cake in poultry rations is limited locally and internationally. This study evaluates graded levels of *Adansonia digitata* seed cake as a protein replacer in broiler chick diets in terms of its effect on performance and production economy.

MATERIALS AND METHODS

Birds, housing, and experimental design

This experiment used 200 unsexed Ross 308 strain chicks in a four treatments × five repetitions × 10 birds arrangement. The birds were distributed on day 7 based on weight. The experiment was conducted at the Poultry Houses, Department of Poultry, Faculty of Agriculture, Omdurman Islamic University-Elfitaihab Campus, Khartoum State, with a mean annual temperature range of 22-27 °C. Houses were open systems measuring 2.5 x 11 x 20 m, oriented east-west, with wire mesh covering the sides.

Chicks were prepared for one week before the experiment by feeding a pre-starter ration and dosing oral prophylactic antibiotic Neoxyvital (Oxytetracycline, Keln N.V., Belgium) plus water-soluble multivitamins (Nutra-VitPlus Amino acid, Nutri Farm, Athens, Greece) for five days. Chicks were vaccinated against Newcastle disease on the 5th day (and later on the 22nd day and Gumboro on the 12th day. Access to feed and water was ad-lib.

Chemical analyses of test *Adansonia digitata L* (Tebaldi) seed cake

Adansonia digitata L. (Tebaldi) seed cake was obtained from Saied Mill, Omdurman Popular Market. The proximate chemical composition is shown below in Table 1.

Table 1. Proximate Chemical Composition (Dry Matter Basis) of *Adansonia digitata* L. (Tebaldi) Seed Cake

Components	Percentage
Dry matter	93.75
Crude protein	22.75
Crude fat	07.62
Crude fiber	34.63
Ash	05.07
Nitrogen-free extract	23.68
Energy (Mcal ME /Kg)	01.99

Experimental rations

Four experimental rations for groups A, B, C, and D were formulated as semi-iso-caloric and semi-iso-nitrogenous according to poultry requirements [15]. Tables 2 and 3 show ingredient inclusion rates and the calculated proximate chemical composition, respectively. Tebaldi seed cake was included at graded levels of 5, 10, and 15% in treatments A, B, C, and D, respectively, partially replacing the experimental rations' total dietary crude protein. Ration A served as the control diet. Experimental feeding was continued *ad libitum* for six weeks.

Table 2. The Percent Inclusion Rate of Ingredients (Fresh-Weight Basis) of Experimental Rations

Ingredient	Percent inclusion rate

	A	B	C	D
Sorghum	66.15	64.00	61.15	58.00
Groundnut cake	26.50	24.00	22.50	20.65
Tebaldi seed cake	00.00	05.00.	10.00	15.00
Concentrate	05.00	05.00	05.00	05.00
Di-Ca-Phosphate	01.00	00.90	00.50	00.50
Ca	01.00	00.75	00.50	00.50
Salt	00.25	00.25	00.25	00.25
Choline	00.10	00.10	00.10	00.10
Total	100	100	100	100

Table 3. Analyzed Proximate Chemical Composition (Dry-Matter Basis) of Experimental Rations

Component	Percentage			
	A	B	C	D
Dry matter	92.36	93.83	93.99	94.00
Crude protein	23.12	22.80	22.80	22.70
Crude fat	03.74	03.90	04.10	04.20
Crude fiber	04.40	05.80	05.60	05.30
Ash	03.80	03.80	03.90	03.90
NFE	57.30	57.53	57.50	58.90
Energy (Mcal ME / Kg)	03.17	03.17	03.18	03.24

Proximate analysis was conducted by AOAC procedures.

Data collected

Data were collected weekly on live weight and daily on feed intake. Two birds from each replicate were sacrificed for carcass analysis at the end of the experimental feeding. Slaughter followed the Islamic procedure of effective bleeding by severing the two left and right carotids and veins. After bleeding and plucking, the carcass was cooled before evisceration. Head and feet were severed, and the cold, eviscerated carcass was weighed.

Economic Appraisal

The total cost of chick purchase, feed, and management was calculated. From the carcass weight was calculated the lean price/kg to determine total return, then central input/output data per head in Sudanese currency were calculated and net profit, profitability, and the profitability ratio for feeding graded levels of Tebaldi seedcake to broiler chicks for six weeks were determined.

Statistical analysis

Data on chick performance and carcass values were subjected to a one-way Analysis of variance (ANOVA) using SPSS version 20.0 (SPSS 2011) [16] to determine the treatment effect on broiler performance parameters and carcass characteristics. When significant treatment effects were identified, the treatment means for the significant effects were separated by the least significant difference (LSD) test at $P < 0.05$.

RESULTS AND DISCUSSIONS

The study estimated the effect of graded levels of *Adansonia dgitat* (L. Tabaldi) seedcake on broiler performance over six weeks. The results are shown in Table (4) found significant improvements in final weight and daily weight gain with a 5% level of baobab seedcake addition, and also acquired the highest total weight gain (2.84±0.22 kg) in contrast, the 15% inclustion (group D) resulted in lower final weights (2.50±0.10 kg) and a higher FCR of 2.00±0.80, indicating reduced efficiency likely to higher anti-nutritional factors. Importantly, there were no mortality records, suggesting safe consumption because vitamin C and anti-nutritional factor concentrations were within acceptable limits, supporting healthy intake and immune function among the birds.

Table 4. Analysis of Variance and Average Performance Values of Treatment Groups Fed Graded Levels of Tebaldi Seed Cake for Six Weeks

Items	F values	Treatments			
		A	B	C	D
Initial weight (gm)	0.1^{NS}	163.50^{a}±00.32	163.70^{a}±00.10	163.50^{a}±00.35	163.70^{a}±00.08
Final weight (kg)	3.3*	02.79^{a}±00.24	02.87^{a}±00.15	02.63^{a}±00.20	02.50^{b}±00.10
Total live weight gain(kg)	13.1^{**}	02.62^{ab}±00.20	02.84^{a} ±00.22	02.45^{b} ±00.20	02.44^{b} ±00.25
Daily weight gain (g)	3.3^{*}	55.70^{ab} ±05.20	60.50^{a}±04.20	52.20^{b} ±04.30	51.80^{b} ±05.40
Total feed intake (kg)	0.4^{NS}	04.92^{a} ±00.17	04.90^{a}±00.20	04.87^{a} ±00.18	04.93^{a} ±00.18
Daily feed intake (g)	0.5^{NS}	104.40^{a} ±03.50	106.30^{a}±04.20	103.50^{a}±03.80	104.80^{a} ±03.60
Daily protein intake (g)	6.3^{*}	$26,40^{ab}$ ±00.66	25.10^{c}±00.82	25.80^{bc} ±00.52	26.80^{a} ±00.56
Protein efficiency ratio	6.2^{*}	02.40^{b} ±00.18	02.90^{a}±00.20	02.30^{b} ±00.16	02.20^{b} ±00.20
Daily energy intake (Mcal ME/kg)	0.7^{NS}	13.60^{a} ±00.45	13.72^{a}±00.56	13.32^{a} ±00.50	13.38^{a} ±00.49
FCR	3.7^{*}	01.80^{b}±00.13	01.70^{b}±00.11	01.90^{ab}±00.15	02.00^{a}±00.80

Note: Different letters in the same column indicate highly significant differences (P<0.05)

Dietary treatment significantly affected slaughter and cold carcass weight (P>0.05), with group B recording the highest values. Remarkably, dressing percentage was higher in the control group, as shown in Table 5; however, this difference was statistically nonsignificant. (P>0.05). This lack of significance likely reflects the high standard deviation (±2.50) in the control group, indicating the highest individual variability and reducing the treatment effect.

Table 5. Analysis of variance and average (mean ± s.d) carcass values of treatment groups fed graded levels of Tebaldi seedcake for six weeks

Item	F Value	Treatment			
		A	B	C	D
Initial weight (g)	0.1^{NS}	163.50^{a}±00.32	163.70^{a}±00.10	163.50^{a}±00.35	163.70^{a}±00.08
Slaughter weight (kg)	3.3^{*}	02.79^{a}±00.24	02.87^{a}±00.15	02.63^{a}±00.20	02.50^{b}±00.10
Cold carcass weight (kg)	1.9^{*}	02.27^{b}±00.24	02.44^{a}±00.15	02.14^{b}±00.21	01.89^{c}±00.13
Dressing percentage	1.5^{NS}	72.10^{a}±02.50	66.10^{a}±01.70	66.10^{a}±01.70	66.40^{a}±01.00

Note: Different letters in the same column indicate highly significant differences (P<0.05)

From an economic perspective, Table 6 shows that Group C (10% inclusion) was the most viable, yielding the lowest production cost (23.00 SDG) and the highest net profit (22.36 SDG) in

Sudanese currency. This group also achieved a superior profitability ratio of 1.70 compared to the control

Table 6. Central Input/Output Data (per Head*) in Feeding Graded Levels of Tebaldi Seed Cake to Broiler Chicks for Six Weeks

Item		Treatments			
		A	B	C	D
Major inputs	Chick purchase	04.50	04.50	04.50	04.50
	Feed	20.30	17.40	14.00	16.80
	Management cost	04.50	04.50	04.50	04.50
	Total cost	29.30	26.40	23.00	25.80
Major outputs	Carcass weight	2.003	2.009	1.972	1.653
	Lean price /kg	23.00	23.00	23.00	23.00
	Total returns	46.07	46.21	45.36	38.02
Profitability	Net profit	16.77	19.81	22.36	12.22
	Profitability	57.24	75.04	97.22	47.36
	Profitability ratio	1.00	1.31	1.70	0.83

*At current prices (SDG) Feb. 2015.

CONCLUSIONS

This study showed that *Adansonia digitata* (Tebaldi) seed cake can replace a portion of protein in broiler diets without compromising performance when included at appropriate levels. Broilers fed up to 10% Tebaldi seed cake showed comparable growth performance to the control group, with the 5% inclusion level (ration B) producing the highest daily feed intake, weight gain, feed conversion efficiency, slaughter weight, and carcass yield. Although the 15% inclusion level negatively affected growth and carcass traits, the 10% level (ration C) provided the highest economic benefit, yielding the lowest production cost and greatest profit and profitability ratio.

Overall, Tebaldi seed cake is a viable, low-cost, locally available alternative protein source for broiler production. Based on performance and economic outcomes, inclusion levels up to 10% are recommended to optimize growth, feed efficiency, carcass traits, and profitability in broiler production systems.

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AUTHORS' CONTRIBUTIONS

The authors collaboratively designed, executed, and analyzed the study. The primary researcher conducted experimental work, collected data, and drafted the manuscript. The academic supervisors provided supervision, validated the methodology, and made critical revisions. Additional contributors assisted with nutritional evaluation, laboratory analyses, data management, administrative support, and final manuscript preparation. All authors reviewed and approved the final manuscript.

COMPETING INTERESTS

The authors declared that there is no conflict of interest

ETHICAL CLEARANCE

All experimental procedures involving animals were conducted in accordance with established ethical guidelines for the care and use of poultry in research. The relevant institutional committee responsible for animal welfare and research ethics reviewed and approved the study protocol. We took appropriate measures to minimize stress and ensure humane treatment of all animals throughout the study.

GENERATIVE AI DECLARATION

This article was entirely written and developed by the authors without the use of generative artificial intelligence (AI) and AI-assisted technologies in preparing the manuscript.

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