

Chemical and nutritive evaluation of *Jatropha curcas* leaf meal in broiler chicken diets

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Abstract

This study was designed to determine the chemical and nutritive evaluation of *Jatropha Curcas* Leaf Meal on the performance of Broiler chicks. *Jatropha curcas* leaf meal contains 19.51% crude protein but high in crude fibre and also contains some anti-nutritional factors (ANFs). The leaves were harvested, the stalks removed and the leaves chopped to facilitate sun drying for 5 days until they became crispy while still retaining the greenish colouration. The material was milled using a hammer mill with a sieve size of 3.36m to produce leaf meal. The experiments reported in this study were therefore conducted to determine the chemical and nutritive value of *Jatropha curcas* leaf meal in broiler diets. In the first experiment, the leaf meal so prepared was used to formulate broiler starter diets at 0%, 2.5%, 5.0%, and 7.5% dietary levels respectively, using 180, 7-day-old young Marshal broiler chicks with were divided into four groups of 45 birds. Each treatment group was further sub-divided into three replicates of 15 birds. The trial lasted 28 days. In the second experiment, the leaf meal was produced as in experiment one. The leaf meal was used to formulate broiler finisher diets at two dietary levels of 0% and 5.0% inclusion levels respectively using 120, 5-week-old broiler chicks divided into two groups of 60 birds each with three replicates of 20 birds each per treatment. The feeding trial lasted 21 days. At the end of the 21st day, five birds were randomly selected from each treatment for carcass and organ weight evaluation. In both experiments, feed intake of the birds on diets containing the leaf meal were significantly ($p < 0.05$) lower than the control (0%) group except at 2.5% dietary level at the first experiment that compared favourably with the control (0%) group. Body weight gain and feed conversion ratio of the birds were not comparable, except also at 2.5% dietary level of the first (starter experiment) which compared favourably with the control (0%) group. The relative organ weights in the second experiment were also not comparable except the heart. Dietary inclusion of *Jatropha curcas* leaf meal in both experiments reduced feed cost but beyond 2.5% level, cost of meat produced (N/kg) meat increased. The results obtained from these experiments suggests that *Jatropha curcas* leaf meal should not be incorporated in broiler diets beyond 2.5% dietary level.

Keywords: *Jatropha curcas* leaf meal, chemical composition, performance, broiler chicken diet

Introduction

The competition for food and raw materials between humans, animals and industries is a serious problem in developing countries such as Nigeria as the geometric increase in human population limits feed available for the expansion of poultry industry (Esonu *et al.*, 2008).

This has led to increase in production cost of livestock products in Nigeria and consequently animal products are expensive to majority of the population (Esonu *et al.*, 2005). There is an urgent need to replace these costly conventional feed ingredients such as maize, groundnut cake,

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soybean meal, fishmeal etc with cheap and locally available unconventional feed materials. One possible source of cheap and locally available feed materials is the leaf meal of some tropical plants. Leaf meal do not only serve as protein source but also provide necessary vitamins, minerals and some oxycarotenoids that enhances performance (Esonu *et al.*, 2003; D'Mello *et al.*, 1995), also leaf meals does not attract competition between humans, animals and industries. *Jatropha* is a wonder plant in the family of euphorbiaceas and is a multi-purpose and large drought resistant plant with several attributes as potential biofuel crop and livestock feedstuff. It contains 37% oil and has relatively high crude protein content with specific value in livestock feeding (Axelsson *et al.*, 2011). The leaf meal has a proximate composition of 86.39%, dry matter, 19.51% crude protein, 11.93% crude fibre, 2.08% ether extract, 8.47% Ash and 44.40% nitrogen free extract. However, factors such as nutrient imbalance, improper metabolism, presence of anti-nutritional factors and toxic elements in such novel feed ingredient have been implicated in similar products (Emenalom *et al.*, 2009). The objective of this study therefore is to determine the chemical and nutritive evaluation of *Jatropha curcas* leaf meal for broiler chickens.

Materials and methods

The research was conducted at the Teaching and Research Farm of the School of Agriculture and Agricultural Technology (SAAT), Federal University of Technology, Owerri, Imo State, Nigeria. Owerri is in the South Eastern Agro Ecological Zone of Nigeria in the humid tropical area of West Africa. Owerri is situated on longitude 7° 01' 06" E and 7° 03' 00" E and latitude 5° 28' 24" N and 5° 30' 00" N and altitude of 90m. The mean annual rainfall, temperature and relative humidity are

2500mm 26.5-27.5 and 70-80% respectively. The dry season duration is five months and annual evaporation is 1450mm the soil is sandy loam with an average PH of 5.5 (Ministry of Lands and survey Atlas of Imo State, 1984). The leaves of *Jatropha curcas* used for this trial were harvested from the Federal University of Technology, Owerri and its environs. The stalks were removed and the leaves chopped to facilitate sun drying for 5 days until they become crispy while still retaining its greenish colouration. The dried leaves were then milled, using a hammer mill with a sieve size of 3.36mm to produce leaf meal. Sample of the leaf meal was then analyzed to determine the proximate composition (AOAC, 1995 (Table 1) and phytochemical analysis. (Table 2).

Experiment 1

The leaf meal so prepared was used to formulate diets for broiler starter chicks at 0%, 2.5%, 5.0% and 7.5% dietary levels respectively (Table 3). One hundred and eighty (180), 7-day old Marshal broiler chicks were divided into four groups of 45 birds. They were randomly assigned to the four treatment diets in a completely randomized design (CRD), each treatment group was further sub-divided into three replicates of 15 birds and kept in a 4 m x 6m compartment. Heat was supplied during the brooding stage using electric bulbs, feed and water were provided ad-libitum. Feed intake was recorded daily and the birds were weighed weekly. Other routine, poultry management procedures were maintained. The feeding trial lasted 28 days. The data collected were subjected to analysis of variance (Snedecor and Cochran, 1980). Where significant treatment effects were detected from the analysis of variance, means were compared using Duncan's New Multiple Range Tests as outlined by Obi (1990).

Experiment 2

The processing of the leaf meal and the chemical analysis were the same as in experiment 1. The leaf meal so prepared was used to formulate diets for broiler finisher birds at 0% and 5% inclusion levels respectively. Other ingredients were adjusted such that the diets were isonitrogenous and nutrient requirement of the broiler finisher birds were met. The ingredients and chemical composition of the experimental diets are shown in Table 4. One hundred and Twenty, 5-week-old broiler chicks also of Marshal strain were selected from a batch of chicks such that their initial weights were between 1025gm and 1030gm. Based on sex and weight, the birds were divided into two groups of 60 birds each and randomly assigned to the two treatment diets in a completely randomized design (CRD) experiment. Each treatment group was further subdivided into three replicates of 20 birds per replicate and kept in a 6m x 8m compartment. Feed and water were provided liberally. Feed intake was

recorded daily and the birds were weighed weekly. Other routine poultry management procedures were maintained. The feeding trial lasted 21 days. At the end of the 21st day, five birds were randomly selected from each treatment for carcass and organ weight evaluation. The birds were fasted for 24 hours, weighed, slaughtered and bled. Dressing percentage, weight of heart, liver, gizzard and kidney were determined. Data collected were subjected to statistical analysis using T-test as outlined by Snedecor and Cochran (1980).

Results

Experiment 1

The Phyto-chemical and proximate composition of *Jatropha curcas* leaf meal are shown on Tables 1 and 2 respectively, while the nutrient composition of the experimental diet is shown on Table 3. Data on the performance of the birds on the various dietary levels of *Jatropha curcas* leaf meal are presented in Table 5.

Table 1: Proximate composition of *Jatropha curcas* leaf meal

Proximate	Composition (%)
Dry matter	86.39
Moisture	13.61
Crude Protein (% DM)	19.51
Crude Fibre (%DM)	11.93
Ether Extract (%DM)	2.08
Ash (% DM)	8.47
NFE (% DM)	44.40

Table 2: Phytochemical analysis of *Jatropha curcas* leaf meal

Parameter	Composition
Saponin (%)	5.20
Alkanoid (%)	1.80
Tannin	0.26
Flavonoid (%)	0.88
Oxalate (%)	1.94
Phorbal (g/kg DM)	3.5

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Feed intake of the birds on diets containing *Jatropha curcas* leaf meal were significantly ($P<0.05$) lower than the control (0%) group. Body weight gain and feed conversion ratio of the birds on diets containing *Jatropha curcas* Leaf Meal followed the same trend as in feed intake, recording significantly ($P<0.05$) lower value than the group on the control (0%) diet except for the group on 2.5% that compared favourably with the control group. Dietary inclusion of *Jatropha curcas* leaf meal reduced cost of producing one kilogramme of feed, however, at inclusion above 2.5% level, the cost of meat produced increased.

Experiment 2

The chemical composition of *Jatropha curcas* leaf meal was same as in experiment 1, while the nutrient composition of the experimental diets is shown in Table 5. Data on the performance of the treatment birds

are shown in Table 6. Feed intake of the groups were significantly ($p<0.05$) different. Birds on *Jatropha curcas* leaf meal containing diets recorded significantly ($p<0.05$) lower feed intake than the birds on the control (0%) diet.

Body weight gain and feed conversion ratio of the groups were significant ($p<0.05$). Relative Organ weights expressed as percentage of the body weight of the groups were significantly ($p<0.05$) affected by the treatments except the heart. One mortality was recorded in the control group while three mortalities were recorded in the 5.0% group. A veterinary diagnosis revealed the cause to be of bacterial infection and not due to treatment. Dietary inclusion of *Jatropha curcas* leaf meal reduced cost of producing one kilogramme of feed, but this reduction did not reflect in the Naira per kilogramme (N/kg) of meat produced.

Table 3: Composition of broiler starter experimental diets

Ingredients	Inclusion levels of <i>Jatropha Curcas</i> Leaf Meal (%)			
	0.0	2.5	5.0	7.5
Maize	50.00	50.00	50.00	50.00
Soya bean meal	30.00	30.00	30.00	30.00
Jatropha leaf meal	0.00	2.50	5.0	7.50
Fish meal	2.00	2.00	2.00	2.00
Palm kernel meal	2.50	1.00	0.50	1.00
Brewers' Dried Grain	8.00	8.00	7.50	4.50
Wheat offal	3.00	2.00	0.50	0.50
Bone meal	3.50	3.50	3.50	3.50
TM/Vit Premix*	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Common salt	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00
Chemical Composition (% DM):				
Crude protein	22.72	22.11	21.87	21.82
Crude Fibre	4.06	5.50	5.65	5.88
Ether Extract	3.26	3.98	4.05	4.26
Calcium	1.25	1.15	1.15	1.15
Phosphorus	0.46	0.57	0.56	0.58
ME (Kcal/kg)	2872.20	2852	2788.05	2755.75

*To provide the following per kg of feed: Vitamin A 10, 00 iu, Vitamin D 2000 iu, Vitamin E, 5iu; Vitamin k, 2mg; riboflavin, 4.2mg; vitamin B12, 0.01mg; pantothenic acid, 5mg; nicotinic acid, 20mg; folic acid, 0.5mg; choline, 3mg, mg, 56mg; fe, 20mg; cu, 1.0mg

Table 4: Composition of finisher broiler chicken experimental diets

Ingredients	Dietary Inclusion Level of <i>Jatropha</i> Leaf Meal (%)	
	0.0	5.0
Maize	50.00	50.00
Soya bean meal	30.00	30.00
<i>Jatropha</i> leaf meal	0.00	5.00
Fish meal	2.00	2.00
Palm kernel meal	2.50	0.50
Wheat offal	3.00	0.50
Brewer's Dried Grain	8.00	7.50
Bone meal	3.50	3.50
TM/Vit Premix*	0.25	0.25
Methionine	0.25	0.25
Lysine	0.25	0.25
Common salt	0.25	0.25
Total	100.00	100.00
Chemical Composition of the Experimental Diets (% DM):		
Crude protein	20.62	20.57
Crude Fibre	4.08	5.05
Ether Extract	3.23	3.98
Calcium	1.23	1.15
Phosphorus	0.51	0.57
ME (Kcal/kg)	2857.85	2795.00

*To provide the following per kg of feed: Vitamin A 10, 00 iu, Vitamin D 2000 iu, Vitamin E, 5iu; Vitamin k, 2mg; riboflavin, 4.2mg; vitamin B12, 0.01mg; pantothenic acid, 5mg; nicotinic acid, 20mg; folic acid, 0.5mg; choline, 3mg, mg, 56mg; fe, 20mg; cu, 1.0mg

Table 5: Performance of broiler starter chicks fed *Jatropha curcas* leaf meal

Parameters	Dietary levels of <i>Jatropha</i> leaf meal (%)				SEM
	0.0	2.5	5.0	7.5	
Initial body weight (gm)	154.40	154.50	154.17	154.12	1.93
Final body weight gain (9m)	813.24 ^a	765.74 ^a	1625.64 ^b	588.68 ^b	52.85
Body weight gain (gm)	658.84 ^a	611.24 ^a	471.47 ^b	434.56 ^b	29.40
Daily weight gain (gm)	23.53 ^a	21.83 ^a	16.84 ^b	15.52 ^b	5.95
Daily feed intake (gm)	82 ^a .88	78.91 ^a	68.30 ^b	63.76 ^b	3.85
Feed Conversion Ratio (9feed/9gain)	3.52 ^a	3.61 ^a	4.91	4.11 ^b	0.26
Mortality (%)	0.00	0.00	1.00	1.00	
ECONOMIC ANALYSIS					
Cost of feed (N/kg)	102.21	100.64	98.44	97.38	-
Meat produced (N/1kg)	359.70	363.31	483.34	400.23	-
Feed cost savings%	-	1.54	3.69	4.73	-

ab: Means within rows with different superscripts are significantly (p<0.05) different.

Table 6: Performance of broiler finishers fed varying levels of *Jatropha* leaf meal

Parameters	Dietary levels of <i>Jatropha</i> Leaf Meal (%)			
	0.0	5.0	SEM	T-Value
Initial body weight (g)	1030.56	1025.00	29.62	19.56
Final body weight (g)	2422.22 ^a	1320.20 ^b	87.71	4.49
Body weight gain (g)	139166 ^a	539.70 ^b	3.93	13.95
Daily body weight gain (g)	66.27 ^a	14.06	4.50	9.65
Daily feed intake (g/day)	159.71 ^a	85.30 ^b	13.95	7.29
Feed conversion ratio	2.41 ^a	6.07 ^b	0.85	7.65
Mortality	1.0	3.0	-	-
Economic Analysis				
Cost of feed (N1kg)	103.31	96.10		
Meat produced	234.51	583.33		
Feed cost savings (%)	-	6.98	-	-
Organ Characteristics				
Live weight (g)	2135.00	1300	30.71	10.98
Carcass (%)	86.84	55.38	2.71	11.05
Heart (%)	0.45	0.55	0.02	0.03
Liver (%)	1.89 ^a	2.38 ^b	0.08	0.52
Gizzard (%)	2.90 ^a	3.48 ^b	0.06	1.08
Kidney	0.11 ^a	0.19 ^b	0.11	0.03

ab: Means within rows with different superscripts are significantly (p<0.05) different.

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Discussion

The mean values of the proximate composition for *Jatropha* leaf meal is shown in Table 1. The leaf meal of *Jatropha* contains an average of Dry matter value of 86.39% which is lower than that of *Jatropha* seed (97.47%) as reported by Oladele and Oshodi (2007). The crude protein value was 19.5% on dry matter basis, which is in agreement with earlier report (Akintoyo, 2004). This suggests that it is a potential source of nutrient like other tropical shrubs (Emenalom *et al.*, 2009). The relatively high level of crude fibre (11.93%) of the leaf meal could be an advantage in the maintenance of a healthy gastrointestinal tract of animals thus indicating that *Jatropha curcas* leaf can also serve as a fibre source in the diet of non-ruminant animals. The Ether Extract value of the Proximate analysis of the leaf meal (2.08%) was far below the report of Akande *et al.* (2012) for *Jatropha curcas* kernel (52.04%). The phytochemical analysis of *Jatropha curcas* leaf meal (Table 2) showed that it contains some anti-nutritional factors (ANFS) such as tannins, saponin, oxalate, Alkaloid, Flavonoid and phorbol esters which are capable of depressing nutrient digestion, absorption and retention (Ani and Omeje, 2011). Saponin is linked with reduction of palatability and intake of nutrients (Makkar and Becker, 1997). High concentration of oxalate affects calcium absorption, phytate is implicated in decreasing protein digestibility by forming complexes and also interacting with enzymes such as trypsin and pepsin (Reddy and Pierson, 1994), it also forms complexes with divergent minerals thereby decreasing the bioavailability of these elements for absorption (Oboh *et al.* 2003). Phorbol esters are known for their inflammatory action resulting in irritation and toxicity (Goel *et al.*, 2007). The poor performance of the broiler starter chicks on diets containing *Jatropha curcas* leaf meal beyond 2.5%

dietary level in experiment 1, was however not surprising. These diets had lower energy values and high fibre content. Enzyme production, efficacy and system of the birds at this stage is not yet fully developed to handle such high fibrous material resulting in low digestibility of nutrients particularly protein and energy required to sustain rapid growth (Esonu *et al.*, 2003; Esonu *et al.*, 2008). Moreover, the poor performance of these broiler chicks could also probably be as a result of the presence the anti-nutritional factors and phorbol esters present *Jatropha curcas* leaf meal (Makkar and Becker, 1997; Goel *et al.*, 2007; Ani and Omeje, 2011). In the broiler finisher experiment, birds on *Jatropha curcas* leaf meal performed poorly in all the parameters measured than the control (0%) group. This decline could be attributed to the reduced feed intake, utilization of nutrients and poor efficacy of feed conversion, and the presence of anti-nutritional factors in the leaf meal which inhibited growth performance of the birds (Ani and Omeje, 2011; Goel *et al.*, 2007). Organ weight is an index of nutrient retained by the birds (Esonu *et al.*, 2008). The observed trend in the organ weights is probably as a consequence of increased activity of these organs in detoxifying the anti-nutritional factors ingested by birds on the diet containing *Jatropha* leaf meal. Dietary inclusion of *Jatropha curcas* leaf meal at all levels in both experiments reduced feed cost but beyond 2.5% levels, cost of meat produced (N/kg meat) increased. The results obtained from these experiments, suggests that *Jatropha curcas* leaf meal should not be incorporated in broiler diets beyond 2.5% dietary level.

Conclusion

The study showed that *Jatropha curcas* leaf meal could be incorporated in Broiler chicken diets at 2.5% dietary level without deleterious effect.

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Received: 20th July, 2020

Accepted: 29th September, 2020