Research Article

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Journal of Animal Research and Nutrition
ISSN 2572-5459

2021
Vol.6 No.5:93

Assessing Protein Value of Cassava (Manihot Esculenta Crantz) Leaf Meal: Effect on Feed Intake, Growth Performances and Carcass Characteristics of "Potchefstroom Koekoek" Chicken

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Citation: Getiso A, Asrat M, Tesfaye E (2021) Assessing Protein Value of Cassava (Manihot Esculenta Crantz) Leaf Meal: Effect on Feed Intake, Growth Performances and Carcass Characteristics of "Potchefstroom Koekoek" Chicken. J Anim Res Nutr. Vol.6 No.5:93.

Abstract

A 115-days feeding trial was conducted on 225 Koekoek day-old chicks at DubboMante experimental site of AARC in a completely randomized design to evaluate feed intake, growth performance and carcass yield of Potchefstroom Koekoek chicken fed cassava leaf meal at dietary levels of 0, 3, 6, 9 and 12 in T1, T2, T3, T4 and T5respectively. The experiment lasted for 13 weeks after two weeks of brooding period. Feed intake and body weight were measured in a daily and weekly basis, respectively. At the end of the experiment, two chickens (cockerel and pullet) per replicate of each treatment were randomly selected, fastened overnight, weighed and slaughtered for measurements of carcass traits. Final body weight and daily body weight gain were higher for T1 [837.91 g and 8.22 g/day, respectively] with no significant difference [p>0.05] between T2, T3, T4 and T5. Chickens kept under T1 [837.91 g and 8.22 g/day] and T2 [788.47 g and 8.17 g/d] were similar in these parameters. Feed conversion ratio were unchanged [p>0.05] across the treatments. Non- significant [p>0.05] differences were observed in slaughter weight, Breast, Drumstick, Thigh, Back, wing, total carcass across and dressing percentage across the treatments. Sex had significantly [p<0.001] affected both daily body weight gain and final body weight of birds. Male chickens gain more during the experimental period and thus achieved a higher body weight at the end. Neither mortality nor health problem was caused by Cassava leaf meal. Hence the results of this study revealed that inclusion of Cassava leaf meal up to 12% can be incorporated in a starter and grower diets of dual-purpose chicken without a marked detrimental effect on the growth as well on the carcass quality parameters.

Keywords: Dual purpose; Potchefstroom Koekoek; Manihotesculentacrantz

Received: March 21, 2021, **Accepted:** April 16, 2021, **Published:** April 23, 2021

Introduction

Shortage of cereals has recently been a serious issue in several regions of the world; in many of these the use of cereal products as livestock feeds is increasingly unjustified in economic terms. Monogastric animals like poultry are markedly affected by such a trend. Feed cost for poultry accounts about 70-85% of the total production cost [1,2]. The bulk of the feed cost arises from protein concentrates such as groundnut cake, fish meal and soybean meal. Prices of these conventional protein sources have soared so high in recent times that it is becoming uneconomical to use them in poultry feeds [1,3]. There is a need therefore to look for locally available and cheap sources of protein feed ingredients, particularly those that do not attract competition in consumption between humans and livestock. Hence, evaluation of potentially useful unconventional feed resources is important in order to increase the resource base for livestock production in general and for chicken rearing in particular. One possible source of cheap protein is the leaf meal of some tropical legume and plants. Limited data on cassava leaf meal (CLM) indicate that these products might be used, at low levels, as pigmenting agents, or, at higher levels, as partial substitutes for the conventional protein sources in poultry rations. Some reports indicated that CLM could be included at up to 20% in broiler rations [4]. For replacement pullets, the maximum possible inclusion level was 16.5% of pelleted rations, whereas with layers, where it was used as carotenoids source, a maximum level of 5% is recommended [4]. The limiting anti-nutritional factors to use CLM as source of protein for poultry are the hydrocyanic acid (HCN) contents, its low energy, bulkiness and possibly their tannin content. Enriquez and Ross,demonstrated that supplementation of methionine at 0.15 to 0.20% of diets could help overcome the HCN toxicity and restore chick performances to normal levels. Leaf meals do not only serve as protein source but also provide some necessary vitamins, minerals and also oxycarotenoids, which cause yellow color of broiler skin, shank and egg yolk [1]. Therefore, this study was designed to examine the nutritional value of cassava leaf meal in growth performance and carcass characteristics of Potchefstroom Koekoek chicken.

Objectives

To assess the effect of feeding dried cassava leaf meal on growth performance of chickens

To evaluate the effect of feeding cassava leaf meal on carcass characteristics of Potchefstroom Koekoek chicken.

Material Method

Experimental Site

The experiment was conducted at the Areka Agricultural Research Center, Dubbo Livestock Experimental site. The center is located in South part of Ethiopia in Wolayta Zone of the Southern, Nations, Nationalities and People's Regional state some 300 kilometres south west of the capital city, Addis Ababa.The center is located at 7o 09'0 N latitude and 37o 47' E longitude at an elevation range of 1750 to 1800m above sea level (a.m.). The average annual rainfall of the study area was 1539mm, and minimum and maximum mean temperature were 14.5oc to 25.8oc respectively.

Preparation of leaf meal

The cassava leaves used for this experiment was harvested from Areka Agricultural Research Center plant science research work farm site. The cassava variety used for this experiment was locally named "kule". Several studies have demonstrated that, it is possible to produce cassava leaf meal (CLM) with low cyanide levels [5-7]. Simple sun-drying alone eliminates almost 90% of the initial cyanide content from leaf. When combined with chopping and wilting, cyanide in the dried meal was reduced to levels which are safer for monogastric animals [7]. So, the leaves were chopped for faster and effective drying on plastic sheet. The chopped leaves were sun-dried for three days until they become crispy while still retaining the greenish coloration. The leaves were turned regularly to prevent uneven drying and possibly decay of the leaves. The dried leaves were then milled using a hammer mill to produce leaf meal.

Chemical analysis of cassava leaves

The nutrient compositions (proximate analysis) of cassava leaves were used from previously analysed results (literature) for treatment formulation (**Table 1**).

Management of experimental birds and design of the experiment

Two hundred twenty five day old Koekoeck chicks were used for this experiment. The chicken were divided in to five groups identified as T1, T2, T3, T4 and T5 consisting of 60 chicken per group. Each treatment group was further replicated 3 times with 20 chicken per replicate. Based on the chemical composition of the ingredients used for experiment five starter and grower diets were formulated to contain cassava leaf meal at 0% [T1], 3% [T2], 6% [T3], 9% [T4] and 12% [T5] and fed to the experimental birds in a Completely Randomized Design (CRD). Water was provided ad libitum. The necessary routine vaccination and veterinary attention was provided (**Tables 2 and 3**).

Data collection

Feed was offered daily on group basis in two halves; first half in the morning after the refusal is collected and weighed while the second half was offered in the afternoon. Body weight was measured at the beginning and every week during the experiment period. The chicks were weighed early in the morning prior to feeding using a digital balance. From the collected data, feed intake and body weight gain and feed conversion ratio were calculated. The amount of dried cassava leaf meal required for the feeding trial was determined based on the total number of chicks and duration of the trial. Mortality was recorded throughout experimental period as it occurred.

Feed Conversion Ration

Feed conversion ratio was determined per replicate by calculating the weight of feed consumed per live weight gain of chicks. Hence Feed conversion ratio was calculated as a ratio of feed intake to weight gain.

Table 1. The chemical composition of Cassava leaf meal used for this experiment.

No.	CP	CF	EE	Ash	ME (Kcal/kg)	Ca	P	Reference
1	25.1	11.4	12.7	9.1	3259.42	1.4	0.3	Iheukwumare et al.
2	21	20	5.5	8.5	2129.40	1.4	0.45	Allen
3	18	14.1	9.4	7.9	2529.37			Akinfala et al.
4	23.2	21.9	4.8	7.8	1591.35			Khajarern and Khajarern
5	21.17	16.35	3.16	13.6	2117.78	1.62	0.29	Mzengerezak et al.
6	25.32	10.63	11.77	8.48	3302.42			Abu et al.
7	19.8	12.9	7.9	7.41	2934.20	2.1	0.8	Morgan and mingan
Average	21.94	15.33	7.89	8.97	2551.99	1.63	0.46	

CP (crude protein %), CF (Crude fiber %), EE (Ether Extract %), ME (Metabolizable energy Kcal/kg DM), Ca (Calcium %), P (Phosphorus %)

Table 2. Ingredient composition of the starter experimental diets (% on DM basis).

Ingredients	Varying Dietary Levels of Cassava Leaf Meal (CLM)				
	T_1 (0%)	T_2 (3%)	T_3 (6%)	T_4 (9%)	T_5 (12%)
Maize grain	60.00	54.65	57.15	60.00	59.30
Wheat middling	5.50	7.8	6.2	3.00	3.00
Nougseed cake	6.00	8	8	2.02	1.80
Soybean meal (toasted)	25.00	24	20	23.00	21.00
CLM	0.00	3	6	9.00	12.00
Salt	0.30	0.5	0.5	0.30	0.30
Vitamin premix	0.50	0.5	0.5	0.50	0.50
Limestone	2.35	1.2	1.2	1.80	1.65
DL-Methionine	0.15	0.15	0.15	0.13	0.15
DL-lysine	0.20	0.2	0.3	0.25	0.30
Calculated ME (Kcal/Kg DM)	**2798.05**	**2767.35**	**2822.48**	**2864.95**	**2877.49**
CP (%)	19.09	19.91	18.82	18.48	18.16

Starter feed=CP=20.5%, ME kcal/kg DM=3000

Table 3. Ingredient composition of the grower experimental diets (% on DM basis).

Ingredients	Varying Dietary Levels of Cassava Leaf Meal (CLM)				
	T_1 (0%)	T_2 (3%)	T_3 (6%)	T_4 (9%)	T_5 (12%)
Maize grain	60.00	60.00	60.00	60.00	60.00
Wheat middling	12.00	10.90	10.00	9.19	8.40
Nougseed cake	4.30	4.00	3.00	2.00	1.00
Soybean meal (toasted)	20.00	18.50	17.57	16.50	15.50
CLM	0.00	3.00	6.00	9.00	12.00
Salt	0.30	0.30	0.30	0.30	0.30
Vitamin premix	0.50	0.50	0.50	0.50	0.50
Limestone	2.55	2.40	2.18	2.00	1.80
DL-Methionine	0.12	0.12	0.12	0.15	0.15
DL-lysine	0.23	0.28	0.33	0.36	0.35
Calculated ME (Kcal/Kg DM)	**2759.8**	**2785.4**	**2810.1**	**2833.2**	**2856**
CP (%)	17.30	17.05	16.84	16.60	16.37

Grower feed=CP=16%, ME kcal/kg DM=2800

$$FCR = \frac{\text{Weight of dry feed fed [g]}}{\text{Live weight gain of chicks [g]}}$$

Measurement of carcass characteristics

At the end of the feeding trial, two chickens [one cockerel and one pullet] from each of the 3 replicates of the 5 dietary treatments, whose final body weights are closest to the average body weight of their respective groups, were selected. They were deprived off feed overnight, weighed and slaughtered in the morning by severing the jugular vein to allow complete bleeding. Then, the birds were defeathered by hand plucking, eviscerated and carcass cuts were determined. The un-eviscerated carcass was weighed. Carcass weight was apportioned into back (thorax + lumbar), two thighs, two drumsticks, two wings, a breast and neck. Edible offal included skin, liver and gizzard. Dressing percentage was calculated as percent of dressed carcass to slaughter weight. Slaughter weight is described here as a live weight taken after overnight starvation of the selected chickens for slaughter.

Data analysis

The data were subjected to ANOVA and the general linear model procedure of SPSS (IBM® SPSS® version 20) was employed to perform all ANOVAs. Effect of sex was taken into account in all parameters studied except feed intake and FCR since these results are presented as replication (experimental pens) means containing chickens of mixed sex.A two between-subject one within-subject factor repeated measure ANOVA was employed for DBWG whereas, FCR was analyzed by one between-subject one within-subject factor repeated measure ANOVA. Final body weight and carcass were analyzed by two-way ANOVA and feed intake by one-way ANOVA techniques. The differences in mean values of the treatments were separated by Duncan Multiple Range Test.

Results and Discussion

Effect of feed on performance of chickens

(**Table 4**) shows the average final body weight, daily body weight gain, feed conversion ratio and feed intake of Koekoek chickens fed diets with different levels of Cassava leaf meal. Mean daily body weight gain and final body weight of chickens fed T3, T4 and T5 were not significantly [P>0.05] influenced by the inclusion of

Table 4. Growth performance of *Potchefstroom Koekoek* chickens fed diets with different levels of *Cassava* leaf meal

Parameters	Dietary treatments					SEM	Sig
	T1	T2	T3	T4	T5		
Initial body weight (gm)	46.84	47.71	46.09	46.76	46.76	1.19	0.397
Final body weight (gm)	837.91[a]	788.47[ab]	723.16[b]	724.86[b]	699.94[b]	29.35	0.03
Feed intake (gm/day)	51.2	50.1	50.1	50.1	50.9	1.14	0.19
DBWG (gm/day)	8.22[a]	8.17[ab]	7.46[b]	7.45[b]	7.21[b]	0.131	0.023
FCR (g feed/g gain)	4.88	4.99	5.37	5.50	5.78	0.35	0.47

Mean values within the same row bearing different superscript letters are significantly different (p<0.05); T1 = 0% CLM; T2 = 3% CLM; T3 = 6% CLM; T4 = 9% CLM; T5 = 12% CLM; SEM = standard error mean; p = probability value

cassava leaf meal in the diets. Chickens fed T1 were significantly [P<0.05] higher than T3, T4 and T5 in final body weight and mean daily body weight gain but not varied with T2. Feed intake was similar [P>0.05] for the groups on all treatments. The statistically lower final body weight and daily weight gain of the chicken at 12% level of cassava leaf meal might be due to the fact that feed intake was low due to high bulk or fibre content of the leaf meal resulting insufficient consumption of digestible nutrients particularly protein and energy required to sustain rapid growth. This result is agreed with the reports of Iheukwumere et al. that cassava leaf meal at 15% level of inclusion lowered broilers body weight gain. This could be due to the effects of nutrient imbalance and poor metabolism on monogastric animals fed high levels of unusual feed ingredients [1,3]. This nutrient imbalance is in the case of cassava leaf meal could probably occur due to the presence of anti-nutritional factors like Cyanogenic glucosides and tannins [8], which could disorder the bioavailability of nutrients. Regarding to feed conversion ratio, although the difference was not significant [p>0.05], birds that received the ration with 12% cassava leaf meal converted feed to mass less efficiently than the remaining groups. The highest value of feed conversion ratio in T5 [12% cassava leaf meal] indicating that the higher the level of cassava leaf meal, which could be due to incapability of the birds to extract required nutrients from the feed because of the effect of anti-nutritional factors which reduced feed digestibility and utilization.

Effect of sex on performance of chickens

The effect of sex on DBWG of chickens according to age is illustrated in (**Figure 1**). Sex had significantly [p<0.001] affected both daily body weight gain and final body weight of birds. Male chickens gain more during the experimental period and thus achieved a higher body weight at the end. This could be endorsed to the differences between sexes probably arising from metabolic differences and also from the differences in the onset of fattening of chickens as suggested by Ng'ambi et al. Fassill et al. had also reported that more gain and higher body weight for growing male birds than females. This is in fact associated with higher feed intake and conversion efficiency of male birds [9]. The graph indicated (**Figure 1**) indicates that, the growth pattern of chicken showed increasing trend up to the tenth weeks and then decreased, which suggests that the maximum rate of growth was attained at this growth stage [10th week]. This result is in agreement with Tera, who revealed consistent improvements in daily body weight gain of Rhode Island Red chickens as age go forward, whereas from the age of 10 to 12 weeks, the difference

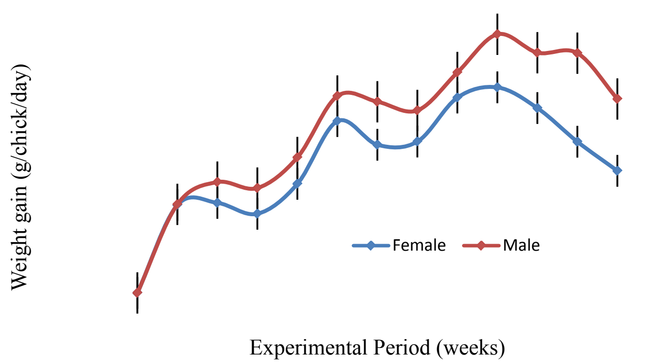

Figure 1 Effect of sex on weekly mean daily body weight gain of *Potchefstroom Koekoek* chickens fed diets with different levels of *Cassava* leaf meal over a period of 13 weeks; error bars are at 95% confidence interval.

in daily body weight gain of chickens remained insignificant when maximum rate of growth was achieved. However, the highest weight gain for meat strain birds was attained at week 7 [8] and then it declines as the age advances. As reported by Tera, dual purpose breeds are known to manifest their growth potential at later ages than broilers probably about ten [10] weeks of age. This variation between dual purpose chicken types and broilers could be due to the differences in their genetic make-up since the broiler breeds have been lengthily selected for rapid growth performance [8]. Hence, the Potchefstroom Koekoek chickens of the current study are so a dual-purpose breed that they showed a higher growth rate at later ages is fathomable.

Carcass characteristics of chickens

The effect of feeding various levels of cassava leaf meal on slaughter weight, dressed carcass, dressing percentage and weights of different body parts and organs of the experimental birds is shown in (Table 5). Except skin, liver and edible offal, inclusion of cassava leaf meal didn't produce significant [P>0.05] effects on carcass trait. Sex had significantly [p<0.001] affected drumstick, thigh, back, wing and total carcass and higher values were scored for male chicken than female. Also, carcass parameters those didn't show statistically difference [P>0.05] on sex, were pronounced higher values for males than females. This variation related to sex of chickens is accredited to the presence of androgen hormone in males that boosted muscle development than the estrogen hormone in females which is commonly more accountable for fat deposition than muscle tissue development

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[9-11]. This is could be due to the biological fact that the weight of adipose tissue is lighter than that of muscle tissue [12] from the latter being denser than the former [10]. This result is in agreement with Negesse and Tera who reported higher carcass vales were pronounced for males of RIR dual-purpose chickens.

Conclusion

Neither mortality nor health problem was instigated by feeding different levels of cassava leaf meal to Koekoek chickens. Hence the results of this study revealed that inclusion of Cassava leaf meal up to 12% can be incorporated in a starter and grower diets of dual-purpose chicken without a noticeable harmful effect on the growth as well on the carcass quality parameters. Further research is necessary to determine how to increase the nutritive value of cassava leaf meal for monogastric animals in view of its cheapness and abundance.

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