

Evaluation of the Carcass Parameters of Growers Fed on Cassava (Manihot Esculenta Crantz) Leaf and Root Mixture

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ABSTRACT
Rapid increase in human population and feed competition between human, poultry and other livestock resulted in shortage of poultry feed. Feed accounts the highest cost in poultry production. To make poultry production more profitable, it is a must to reduce production cost. Consequently, locally available non-conventional feed sources should be searched out and used in order to alleviate the problem. Thus, the present experiment studied the effect of inclusion rate of cassava leaf and root mixture (CLRM) on the performance of grower male white leghorn chicks at Wolaita Sodo ATVET College. The objective of the study was to investigate the carcass parameters of growers fed on CLRM. The collected cassava leaves and roots were separately chopped, dried, ground and then mixed in the ratio of 50:50 to get CLRM. Four diets were formulated, T1 contained no CLRM and served as the control, diets T2, T3 and T4 had CLRM at levels of 7.5, 11.25 and 15%, respectively. The grower chicks kept in a deep litter system and the feeding trial lasted for twelve weeks. A total of 180, eight weeks old grower chicks with average initial body weight of 495.68±26.74g (mean±SD) were randomly assigned to 4 experimental groups. Each group was replicated thrice with 15 chicks per replicate. A completely randomized design (CRD) experiment was used. The birds were given known amount of feed and water ad libitum throughout the experimental period. Data were collected on carcass characteristics. The chemical analysis showed that, the crude protein (CP) and metabolizable energy (ME) contents of CLRM were 14.5% and 3061.63 kcal/kg DM, respectively. The result of the experiment showed, there was no significant ($P>0.05$) difference in mean slaughter weight, carcass characteristics between treatments. The mean slaughter weight of T3, T4, T2 and T1 was 1743.7, 1692.3, 1661.0 and 1604.0 gram, respectively. Economic analysis showed that feed cost per bird was lower in the CLRM based diets than the control group. Similarly, the highest net return and marginal rate of return was noted for T3. The results showed that ration formulation using CLRM, like as in T3 of the present study resulted in better biological and economic performance in grower rations. It was concluded that feeding grower chicks with CLRM at 15% of the ration can be used without any adverse effect on the carcass weight of the birds.
Keywords Cassava leaf and root mixture, slaughter weight, carcass characteristics, white leghorn

1. INTRODUCTION

Poultry has short generation interval, prolific, easy to rear and its output can be generally expanded more easily than that of other livestock (Reta, 2009). Moreover, it fits well with the concept of small-scale agricultural development and does not compete for scarce land resources. However, more than 80% of the total poultry population in most developing countries is kept in traditional production systems characterized by poor growth rates and long age of slaughter weight (Gueye, 2005). This is because there are different challenges that lead production fall of livestock in general and poultry in particular (Belewu and Fagbcmi, 2007).

Improving poultry productivity would improve protein nutrition and increase the income levels of the rural population (Misba and Aberra, 2013). Solomon (2003) noted that the major reasons for low productivity (low rate of growth and delayed maturity) are low standards of management, healthcare and feeding. Therefore, the productivity of poultry can be improved by different methods like improving nutrition, using more productive birds, better management and disease control. Belewu and Fagbcmi (2007) indicated that nutrition has higher contribution in improving the productivity of chicken. Moreover, one of the major problems of poultry production in Ethiopia is availability and high cost of feeds that contribute more than 75% of all production costs (Mammo and Sultan, 2010).

Although, the agro-ecology in Ethiopian is suitable for crops like cassava which could be a wide option of feed resources for livestock including poultry, its production and utilization has been limited. Cassava products and by products are locally valuable and have low cost for farmers to use as feeds for animals (Saroeun, 2010). Moreover, the roots and leaves of the cassava plant offer potential as a feed source (Tewe, 2004) and they are mainly rich in energy and protein, respectively (Kobawila *et al.*, 2005). For instance, the cassava leaf protein content is high and comparable with some rich conventional protein sources of plant and animal origins (Fasuyi, 2005) whereas cassava root products are rich in carbohydrates and thus are used mainly as sources of energy (Khajarern and Khajarern, 1992). Cassava leaf and root can therefore, serve as fair sources of protein and energy for non-ruminants like poultry. Likewise, the cost of cassava-based rations can be reduced by incorporating cassava leaves to enhance its protein contribution (Tewe and Egbunike, 1992).

Although, cassava leaf and root are cheap sources of nutrients and has better productivity, the extent of practical use in poultry ration is inadequate under Ethiopian condition and limited researches have been conducted on this important crop as a feed ration for grower chicks. Moreover, cassava leaves are left to rot away on farms and homesteads after harvesting (Akinfala and Tewe, 2001). Therefore, the aim of this study was to determine the effect of increasing level of mixture of cassava leaf and root on carcass parameter.

Objective:-

- To evaluate carcass yield of growers fed with different proportions of cassava leaf and root mixture

2. MATERIALS AND METHODS

2.1. Area Description

The experiment was conducted at Wolaita Sodo Agricultural Technical Vocational Education and Training (ATVET) College. The College is found in Wolaita Zone which is located 350 km south west of Addis Ababa with altitude between 700 and 2950 m.a.s.l. and latitude and longitude of 6.49 N and 37.45 E, respectively. Mean monthly temperature (^oC) varies from 11 to 26 (Tsedeke and Endrias, 2011).

2.2. Management of Experimental Birds

A total of 180 male white leghorn (WL) chicks with similar body weight of 495.68±29.95 g (mean ±SD) at the age of seven weeks purchased from Wolaita Sodo Poultry Husbandry Center were selected and distributed randomly into four dietary treatments replicated thrice each with 15 chicks. The already constructed house was separated into 12 pens each measuring 2*2 meter using wooden frames and metal wire mesh. The room was concrete floors and covered with saw dust as a litter material to a depth of 5 cm. The poultry house was cleaned with water and detergent, and then disinfected using formalin (37%) and left for two weeks before the experimental chicks were housed. Standard routine management like draining of remaining water, washing of the watering trough, removal of poultry dropping from the remaining feeds in the feeders on daily basis were practiced as described by Aderemi *et al.* (2006).

2.3. Ingredients and Experimental Rations

Experimental rations are shown in Table 1. The four treatment rations used in this study were formulated on an isocaloric and isonitrogenous basis having 3000 MJ/kg DM of metabolizable energy and 20% crude protein. Ration 1 was made to contain no test feed (control) or 0% cassava leaf and root mixture. Rations 2, 3, and 4 were made to contain 7.5%, 11.25%, and 15% cassava root and leaf mixture for treatments 1, 2, 3 and 4 respectively. Soybean meal, wheat short, methionine, lysine, limestone, vitamin premix and salt were added equally in all treatments rations. Water was provided *ad libitum* on separate troughs for each pen.

Table 1. Proportion of the experimental diet

No	Ingredients (%)	Treatments			
		T1	T2	T3	T4
1	Maize	44.20	36.70	32.63	29.20
2	Cassava leaf and root mixture	0	7.50	11.25	15.00
3	Noug seed cake	34.30	34.30	34.62	34.30
4	Wheat short	10.00	10.00	10.00	10.00
5	Soybean meal	10.00	10.00	10.00	10.00
6	Vitamin premix*	0.10	0.10	0.10	0.10
7	Lysine	0.25	0.25	0.25	0.25
8	Methionine	0.25	0.25	0.25	0.25
9	Salt	0.40	0.40	0.40	0.40
10	Limestone	0.50	0.50	0.50	0.50
Total		100	100	100	100

**premix 1% per kg contains: Vitamins: Vitamin A, 1000000IU; VitaminD3, 200000IU;Vitamin E, 1000mg; Vitamin K, 225mg; vitamin B1, 125mg; vitamin B2, 500mg; vitamin B3, 1375mg; vitamin B6, 125mg; vitamin B12, 1mg; vitamin PP,4000mg; folic acid, 100mg; Choline Chloride, 37500mg; Biotin, 0mg. Trace elements: Iron, 0.45%; Copper,0.05%; Manganese, 0.6%; Cobalt, 0.01%; Zinc,0.7%; Iodium, 0.01%; Selenium, 0.04%; Minerals: Calcium, 29.7%. Other Additives: Anti—oxidant (BHT) 0.05%.*

2.4. Data collection

At the end of the experiment (20 weeks of age) 4 birds per replicate group were randomly selected for carcass and organ weight evaluation after fasting them over night. They were weighed and slaughtered by severing the jugular vein. Birds were bled dipped in hot water, de-feathered by hand plucking and separated into head, neck and feet and visceral organs. After dressing, the following weights were taken: dressed weight, carcass weight, gizzard, liver, heart, neck, shanks, and intestine according to the procedure followed by Zanu *et al.* (2012). Aberra *et al*. (2012) noted that under Ethiopian context the thigh and drumstick, breast, wing, neck and back are the most important edible parts while the gizzard, liver and skin are considered as edible offal and their yield are categorized as carcass weight. Thus, the total edible meat was the sum of carcass weight and edible offal. The dressing percentage was determined by dividing total edible meat by slaughter live weight and multiplied by 100.

2.5. Data Analysis

The data were analyzed as a completely randomized design (CRD) following the procedures suggested by Gomez and Gomez (1984) by employing ANOVA procedure using Statistical Analysis System (SAS Institute, Inc., 2008 version 9.2) computer software program. Least significant difference (LSD) model was used to identify treatments that were significantly different at 5 % of significance level from each other.

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

Where: Y_{ij} = response variable

μ = overall mean effect

α_i = treatment effect

e_{ij} = residual error

3. RESULTS AND DISCUSSION

3.1. Chemical Composition of Ingredients and Experimental Rations

The results of the chemical analysis of the different feed ingredients and the formulated experimental diets are presented in Table 3 and Table 4, respectively. The experimental diets were formulated to meet the minimum nutrient requirement of grower chicks.

Table 2. The chemical composition of feedstuffs (on dry matter basis)

Ingredients	Chemical composition of feedstuffs (%)				
	CLRM	Maize	NSC	Wheat short	Soybean
DM (%)	92.95	91.66	93.20	90.60	93.40
CP (%DM)	14.50	8.20	34.20	15.70	38.90
EE (%DM)	9.99	5.14	8.80	5.21	10.10
Ash (%DM)	5.00	1.80	7.30	6.90	8.10
CF (%DM)	10.70	3.60	19.30	7.60	6.90
Ca (%DM)	1.10	0.04	0.70	0.08	0.30
P (% DM)	1.04	0.25	0.30	0.40	0.60
ME (kcal/kg DM)	3061.63	3602.11	2424.00	3287.50	3570.95

DM=dry matter; CP=crude protein; EE= ether extract; CF=crude fiber; Ca= calcium; P= phosphorus; ME= metabolizable energy; CLRM= cassava leaf and root mixture; NSC= Noug seed cake

The CLRM in the present study was made by mixing one part by weight of leaf meal with one part of root meal. The calculated value indicated that the metabolizable energy (ME) of CLRM was lower than maize, wheat short and soybean meal, but higher than noug seed cake (NSC). However, the crude fiber level of CLRM is higher than the other feed ingredients, except the NSC. Since dietary energy is mainly influenced by CF, CLRM has lower energy feeding value than maize, wheat short and soybean meal. This finding is in agreement with Ochetim (1992) who illustrated that CLRM had relatively low dietary energy than maize. Although the ME of CLRM is low, its crude protein content is comparable with wheat short (15.7%). The CP value of the CLRM of the present study is higher than that reported by Eruvbetine *et al.* (2003; 12.41%). Ochetim (1992) obtained 8.7% CP by mixing one part of dried leaf and three parts of dried root meal. The difference might be due to the proportion of cassava leaf and root mixture that the previous author used in the experiment. Cassava leaf meal is rich in crude protein content (Fasuyi, 2005) while the root is rich in energy (Tewe, 2004). Therefore, reduction of the leaf meal in the mixture will clearly reduce the CP content of the mixture. In addition to this, the age of the leaf during harvest may result difference in CP content. Ravindran and Ravindran (1988) found decrease in CP content from 38.1% in very young leaves to 19.7% in mature leaves, and a similar trend for most amino acids. The EE, CF and ash contents of CLRM in the present study were nearly similar to that reported by Eruvbetine *et al*. (2003, 9.9% EE, 11.09% CF, and 4.56% Ash). The mineral content of CLRM especially calcium and phosphorus were better than the other feed ingredients used in the present study.

Table 3. The Chemical compositions of treatment diets (dry matter basis)

Treatment	Nutrient (%)							
	DM	CP	EE	Ash	CF	Ca	P	ME (Kcal/Kg DM)
T1	92.21	20.62	4.43	8.08	7.60	0.89	0.27	3188.21
T2	91.52	20.93	4.90	9.89	7.85	0.94	0.30	3117.75
T3	92.39	21.25	5.16	10.4	8.08	1.22	0.32	3090.68
T4	92.19	21.81	5.09	10.6	9.01	1.33	0.32	2996.23

DM= dry matter; CP= crude protein; EE=ether extract; CF= crude fiber; Ca=calcium; P= phosphorus; ME= metabolizable energy; T1=ration with no CLRM; T2=ration containing 7.5% CLRM; T3= ration containing 11.25% CLRM; T4= ration containing 15% CLRM.

3.2. Carcass and Organ Characteristics

3.2.1. Mean slaughter, edible offal and dressed weight

The results related to the impacts of CLRM in the diets of grower chicks on slaughter weight, edible offal and dressed weights are summarized in Table 6. The average slaughter weight of the experimental birds was non-significant (>0.05%). The carcass parts such as breast, thigh and drumstick, back, wing, neck and total dressed weight of the experimental birds were similar between treatment groups indicating that dietary treatment did not affect the characteristic of meat. The present study is in line with George and Sese (2012) and Sultana *et al*. (2012) who indicated that the drumstick, wing, neck and breast showed no significant ($P>0.05$) difference regardless of dietary supplementation of cassava meal. It is also in agreement with the result of Olorunsanya *et al.* (2007) and Onibi *et al*. (2008) who noted that cut parts of the carcass followed the same pattern with increasing dietary levels of cassava leaf meals in broiler finisher birds. This indicated that the CLRM did not have any toxin or have the cyanide associated with cassava that is deposited in any of these organs at the level that can cause toxicity (Iheukwumere *et al.,* 2007). There were also no significant differences in dressing percentage. Eruvbetine *et al*. (2003) reported that dietary treatments contained cassava leaf and root mixture had no influence on carcass quality characteristics such as dressed weight.

As it is shown in table 7, the edible offal parts like gizzard and skin have similar characteristics and insignificant in terms of statistical analysis among the four experimental diet. Even if there was no significant difference in terms of gizzard weight, there was a linear increase as the level of CLRM increased. The numerical increase in size of gizzard as CLRM increased in the present study is in line with that reported by Eruvbetine *et al*. (2003) who concluded that the size of the gizzard increased as a result of CLM inclusion in the diet due to higher fiber content in the ration (30% cassava concentrate) as a result of handling bulky feeds. It is also in agreement with the result of Adeyemi *et al*. (2012) who found significant ($P<0.05$) increases in the weights of gizzard as the inclusion of cassava leaf and blood meal mixture increases. The increasing bulkiness of feed with increasing concentration of CLM tends to enlarge gut capacity to enable birds cope with the higher amount of feed intake.

Table 4. The effects of CLRM on the carcass characteristics

	Treatment					
Parameter	1	2	3	4	SEM	SL
Slaughter wt. (g)	1604.0	1661.0	1743.6	1692.3	157.4	NS
Breast wt. (g)	300.67	324.67	327.33	320.33	41.47	NS
Breast (% SW)	18.45	19.55	18.69	18.96	0.35	NS
Thigh and drumstick wt. (g)	325.33	313.33	349.33	317.67	45.35	NS
Thigh and drumstick (% SW)	20.19	18.86	19.96	18.76	0.33	NS
Back wt. (g)	127.33	137.00	138.00	121.00	20.89	NS
Back wt. (% SW)	7.68	8.20	7.93	7.16	0.26	NS
Wing wt. (g)	66.00	67.33	70.00	68.33	7.17	NS
Wing (% SW)	4.10	4.06	4.02	4.05	0.07	NS
Neck wt. (g)	71.67	63.00	65.67	65.33	9.89	NS
Neck (% SW)	4.47	3.81	3.76	3.84	0.14	NS
Carcass wt. (g)	891.00	905.33	950.33	892.67	110.7	NS
Edible offal wt. (g)	187.00	176.33	179.00	178.55	19.29	NS
Total edible wt. (g)	1078.00	1081.67	1129.3	1071.0	119.2	NS
Dressing (%)	67.20	65.12	64.77	63.29	2.60	NS

Total edible= (carcass weight + edible offal); dressing % = (total edible/slaughter weight) ×100; SW=slaughter weight; SW=slaughter weight; SEM= standard error of the mean; SL=significant level; NS=non-significant; T1=ration with no CLRM; T2=ration containing 7.5% CLRM; T3= ration containing 11.25% CLRM; T4= ration containing 15% CLRM.

Table 5. The effects of CLRM on the edible offal

	Treatment					
Parameter	1	2	3	4	SEM	SL
Gizzard wt.(g)	32.0	32.67	34.00	38.00	1.27	NS
Gizzard (% SW)	1.99	1.97	1.97	2.25	0.08	NS
Liver wt.(g)	26.00^{b}	31.333^{ab}	31.67^{ab}	36.67^{a}	5.74	*
Liver (% SW)	1.62^{b}	1.83^{ab}	1.88^{ab}	2.17^{a}	0.08	*
Skin wt.(g)	129.00	112.33	114.00	103.67	18.73	NS
Skin (% SW)	8.07	6.79	6.60	6.10	0.37	NS
Edible offal wt (g)	187.00	176.33	179.00	178.55	19.29	NS

*Edible offal wt. = (gizzard + liver + skin) wt.; NS=non-significant; T1=ration with no CLRM; T2=ration containing 7.5% CLRM; T3= ration containing 11.25% CLRM; T4= ration containing 15% CLRM; ^{ab}Means within the same row bearing different superscripts are significantly different; * = significant at 5 % (0.05).*

3.2.2. Non edible organ parts

Statistical analysis showed no significant difference (p>0.05) among treatment groups in small intestine, lung, crop, spleen, proventriculus and shanks (Table 7). This is in agreement with the findings of Eruvbetine *et al.* (2003) who reported absence of significant differences in weights of crop, and spleen weight as a result of the treatments. The present finding is also in agreement with that of Okorie *et al.* (2011) who suggested that the organ weights of broilers did not present any significant difference between the treatment groups. The higher large intestine weight as CLRM increased of the present study is in line with (Borin, 2005) who noted that high CLM levels in the diet increased the fibre content and had considerable influence on the length and weight of most parts of the gastrointestinal tract and associated organs of poultry. George and Sese (2012) indicated that statistically there was no variation among the shank of bird fed on different feed ingredients containing cassava. The higher weight of liver and pancreas in the CLRM based diet than the control in the present study is also in agreement with (Onibi *et al.*, 2008) who discussed that these organs are possible sites for detoxification hence increased weight with increasing muscular activities due to increased levels of dietary anti-nutrients.

Table 6. Non edible organ parts of chicks fed ration containing different level of CLRM

Inedible offal	Treatment					
	T1	T2	T3	T4	SEM	SL
Head (g)	123.3	118.33	124.67	109.0	3.13	NS
Kidney (g)	7.33^{b}	7.67^{ab}	8.00^{ab}	10.33^{a}	1.58	*
Large Intestine (g)	8.30^{b}	10.33^{a}	9.33^{ab}	9.33^{ab}	1.04	*
Small intestine (g)	34.0	35.0	34.33	39.67	5.04	NS
Lungs (g)	12.67	12.67	12.00	12.33	3.87	NS
Pancreas (g)	2.33^{b}	3.00^{a}	3.33^{ab}	4.00^{ab}	0.82	*
Crop (g)	7.00	6.67	10.33	9.33	2.55	NS
Spleen (g)	2.67	3.33	2.67	3.67	0.65	NS
Heart (g)	10.0	8.33	10.67	9.33	1.22	NS
Proventriculus (g)	5.67	6.00	6.60	6.70	0.83	NS
Shank (g)	58.33	62.33	59.33	61.33	7.06	NS

*All values within rows with the same superscript or no superscript are not significantly different (P > 0.05); *= significantly at P<0.05); SEM=standard error of mean; SL=significant level; T1=ration with no CLRM; T2=ration containing 7.5% CLRM; T3= ration containing 11.25% CLRM; T4= ration containing 15% CLRM; ^{ab}Means within the same row bearing different superscripts are significantly different; * = significant at 5 %.*

4. SUMMARY, CONCLUSIONS AND RECOMENDATIONS

This study was conducted to evaluate carcass parameters fed on cassava leaf and root meal mixture (CLRM). One hundred eighty grower male white leghorn chicks with uniform body weight at the age of 8 weeks were used for the feeding trial. They were reared on deep litter floor covered with saw dust as bedding material. They were randomly divided into four groups and each group further divided into 3 replicates, each replicate with 15 chicks. Each of the four groups of chicks were assigned to one of the four treatment rations which were T1 (diet containing 0% CLRM), T2 (7.5% CLRM), T3 (11.25% CLRM), T4 (15% CLRM). Diets were formulated to be nearly isocaloric with 3000 kcal ME/kg DM and isonitrogenous with 20% CP/kg DM. The experiment lasted for 12 consecutive weeks, during which mean dry matter intake, growth rate, feed conversion ratio (feed consumed/weight gain), carcass yield as well as partial budget analysis were undertaken to evaluate the economic benefits of the different proportions of cassava leaf and root. The experimental design was CRD, and the differences between means wherever significant were tested by the use of the Least Significance Difference test. Statistical analysis showed the mean slaughter weight (1604.0g-1743.7g (SEM=±157.4759)), dressed weight (891.00g-950.33g (SEM=±110.7)) and drumstick-thigh weight (313.33g-349.33g (SEM=±45.35)) were not significantly (P > 0.05) different between the treatment means.

Based on the results of the present study the following recommendations are made:

- CLRM as a feed ingredient for grower chicks at 11.25% inclusion level reduces the production cost and maximizes profit without deleterious effect on the carcass parameters of grower chicks. Therefore, the utilization of this feed stuff by poultry producers should be encouraged to be profitable by reducing production cost.
- Further research on mixing of the cassava leaf and root with same or different proportions should be tested on other classes of birds.

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