Utilization of Cassava Brown Streak Diseased Roots as Replacement for Maize on Growth Performance of Broiler Chickens

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Abstract

Cassava roots afflicted with Cassava Brown Streak Disease (CBSD) were used in a study involving 600 Hubbard broiler chicks to evaluate their utility as a substitute for maize meal in broiler rations. The chicks were allocated to three dietary treatments with varying damages and cassava inclusion levels (CL1 – CL3) each with 60 birds in a complete randomized design. Three diets were formulated to keep ME content at between 12-12.55MJ/kgDM and the CP around 18-20%. The CBSD cassava replaced maize at 25%, 50% and 75%. Average voluntary feed intake per bird for CL1 at 25,50 and 75% inclusions were respectively 130.31±8.46, 110.86±3.32 and 108.76±5.01; the corresponding intakes for CL2 were 104.33±2.20, 105.10±7.02 and 105.31±4.42 ; and for CL3 were 90.06±14.71, 90.06±14.71 and 103.10±4.90. At 50% and 75 % levels of inclusions intakes were significantly lower (P<0.05) than that of the Control diet (128.23±6.53) regardless of class of root damage. The Average Daily Gain (ADG) per bird for CL1 at 25, 50 and 75% inclusion were respectively 30.48± 1.84, 27.57±0.62 and 27.35±0.94; for CL2 were 25.75±1.57, 26.15±2.58 and 24.98±0.84; and for CL3 were 22.17±2.11, 23.11±2.87 and 24.29±1.84. While for control diet was 30.62±1.59. It is concluded that CBSD afflicted cassava can replace Maize meal for up to 25% inclusion level.

Keywords: Cassava, intake, diets, broiler, carcass

Introduction

The poultry feed industry is faced with many challenges that include not only the availability of feed ingredients but also the ability to produce high quality products in a cost-effective manner (Chauynarong *et al.,* 2009). Cereal grains mainly corn are the conventional energy feeds in poultry rations which constitute over 50% of the diet for the different classes of poultry. The rapid growth of human population has intensified the competition between man and livestock for cereals, resulting to prohibitive costs of the cereal grains. High prices of poultry products have led to low levels of per capita poultry meat and egg consumption in Tanzania. This has called for a need to exploit alternative and cheaper energy sources that can replace more expensive cereals (corn and sorghum) for livestock production. One such economical substitute in Tanzania is cassava meal (Tesfaye *et al.,* 2013). Unfortunately, occurrences of diseases such as Cassava Brown Streak Diseases (CBSD) adversely affect the crop such that it is rapidly losing its role as a "food security crop". It is currently estimated that about 10 to 30% of the cassava roots are discarded due to the effect of CBSD in Tanzania and the disease is known to decrease the market value of the roots by 90% (McSween *et al.,* 2006; Mohammed *et al.,* 2012). Afflicted roots would fetch less than 5 US $ per ton compared to 55US $ for fresh healthy roots (Mohammed *et al.,* 2012). Discarding of roots and respective low market values seriously affect many livelihoods. It is imperative, therefore, that ways are developed to eliminate the disease and where possible, alternative uses for afflicted roots should be sought. It is against this background that this study was conducted. The CBSD afflicted roots were used as a substitute for maize in the formulation of broiler rations with the view to determining the most practical and cost-effective levels of maize substitution.

Materials and Methods

Ration Preparation

Cassava roots used in this study were obtained from Agricultural Research Institute (ARI) Naliendele, Mtwara. The roots were ranked into classes of 1 to 5 (Figure 1) based on increasing severity of root necrosis as described by McSween *et al.* (2006).

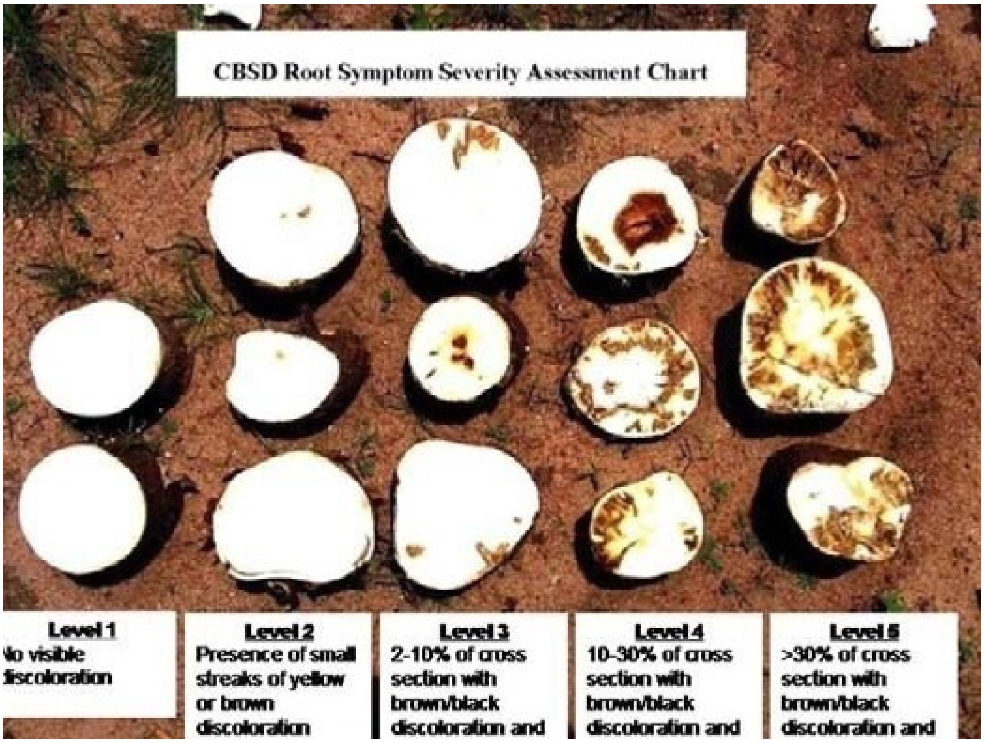

Figure 1: Ranking of cassava basses on severity of root necrosis
Source: McSween *et al.,* 2006

For this study only classes 1 to 3 were used. The unpeeled afflicted cassava roots were chipped and sun dried for three days and then coarsely ground to pass through a 10 mm sieve to produce cassava meal. Cassava and other ingredients used in feed formulation as well as their nutritional composition are summarized in Table 1. A summary of the nutritive value of the rations after compounding is given in Table 2.

Management of Experimental Animals

A total of 600 day old broiler chicks of Hubbard breed were reared at Misenani Agri-services Ltd, at Ilemela district in Mwanza Region. The chicks were brooded for two weeks, receiving ad-lib quantities of standard starter feed based on maize grain, which contain 23%CP and metabolizable energy of 13.40MJ/kgDM. The birds were also vaccinated against Newcastle Disease (ND) and Infectious Bursal Disease (IBD) at the age of 7 and 14 days and repeated at 21 and 28 days respectively. Thereafter, the chicks were allocated in ten dietary treatments formulated (Table 2) under complete randomized design with 60 chicks per treatment replicated in three times. A control diet with 100% maize was also availed.

Feed intake

Chicks received ad-libitum amount of feed daily and the refusals were measured on the next day. The arithmetic difference between offered and refused feeds gave estimates of intake for the group.

Table 1: Nutritive values of the ingredient used for diets formulation

S/No	Ingredient	CP%	ME (mj/kg)	EE%	CF%	DM%	ASH%
1	Maize meal	9.65	15.30	1.57	3.08	93.90	1.24
2	Maize bran	12.17	14.50	4.57	5.88	94.10	4.05
3	Cassava I	3.09	15.04	1.36	3.27	88.10	2.84
4	Cassava II	2.98	14.91	1.57	3.25	85.20	3.58
5	Cassava III	3.09	14.76	1.26	3.80	89.60	3.30
6	Soy cake	37.87	13.84	10.44	12.06	94.40	5.84
7	S/flower cake	26.73	6.94	11.56	33.78	97.00	6.25
8	Fish	32.91	7.66	8.66	2.55	95.60	59.48

CP = Crude protein, ME = Metabolizable energy, EE = Ether extract, CF = Crude fibre, DM = Dry matter

Table 2: Chemical composition of the experimental diets

Diet	DM%	EE%	CP%	CF%	AS%	NFE%	ME (mj/kg)
25%CL1	92.48	7.19	18.20	8.31	14.17	45.76	11.65
50%CL1	92.32	6.00	18.05	6.18	12.25	51.02	12.41
75%CL1	92.32	5.45	20.32	6.77	13.06	48.07	12.08
25%CL2	90.75	7.16	19.87	7.78	7.98	49.33	12.59
50%CL2	92.43	6.13	19.85	7.29	9.51	50.88	12.58
75%CL2	92.35	6.01	21.53	7.58	8.48	50.10	12.68
25%CL3	91.90	6.32	17.91	5.16	9.75	53.98	13.11
50%CL3	87.57	6.38	19.92	6.22	9.03	47.32	12.27
75%CL3	92.79	5.87	19.84	5.94	13.86	48.54	12.33
CTR	90.29	7.12	18.99	6.57	11.69	47.08	12.25

CTR = control 100% maize, DM = dry matter, EE = ether extract, CP = crude protein, NFE = nitrogen free extract, ME = metabolizable energy, 25%CL1= Cassava Class One and Level One of Inclusion 25%, 25%CL2 = Cassava Class Two and Level One of Inclusion 25%, 25%CL3 = Cassava Class Three and Level One of Inclusion 25%, 50%CL1= Cassava Class One and Level 2 of Inclusion50%, 50%CL2 = Cassava Class Two and Level Two of Inclusion 50%, 50%CL3 = Cassava Class Three and Level Two of Inclusion 50%, 75%CL1= Cassava Class One and Level Three of Inclusion75%, 75%CL2 = Cassava Class Two and Level Three of Inclusion 75%, 75%CL3 = Cassava Class Three and Level Three of Inclusion 75%

Growth performances

Body weight was measured weekly for a group 20 birds from each replicate and treatment throughout the experimental period of six weeks. The growth performance was expressed in terms of Feed Conversion Ratio (FCR).

Carcass components

After eight weeks, two broiler chickens were selected randomly from each replicate for slaughter. Carcass weight was measured and then dressing percentage was calculated. Meat samples from thigh, breast and drumstick muscles were taken from each bird and measured.

Data analysis

The data were analyzed by using SAS (2000) software and any variations between treatment means were determined at 5% level of significance. The model for comparisons of treatment effects was:

$Y_{ijk} = \mu + C_i + T_j + (T*C)_k + e_{ijk}$

Where Yijk = response variable (weight changes and carcass characteristics)

μ = General mean effect

Tj = Effect due to the ith level of substitution of maize by CBSD cassava root (i= 1, 2, 3)

Ci = effect of class within the ith treatment (1, 2, 3)

(T*C) k = effect of interaction between damage class and level of cassava inclusion
eijk = Random error.

Results

Mortality rate

Mortality rates of the birds after allocation to treatment diets was 2.3% which suggests that survival and health status of the birds was not affected by addition of CBSD afflicted cassava roots on the diets for the broiler chickens.

Effect of levels of cassava inclusion and root damage on voluntary feed intake

Table 3 presents effect of levels of cassava inclusion and root damage on voluntary feed intake (VFI). Generally there was a trend of increase in feed intake with age in all dietary treatments. The highest intake was observed on the control diet followed by diets with 25% level of cassava inclusion irrespective class of root damage. The lowest intake was observed in diets with 75% level of cassava inclusion. The effects of level of root damage had no significant (P> 0.05) influence on intake; showing inconsistent trend at all levels of cassava inclusion.

Effect of levels of cassava inclusion and root damage on growth performance and feed utilization efficiency

Table 4 shows the effect of levels of cassava inclusion and root damage on initial weight, final weight, average daily gain and feed utilization efficiency. The results show that there was a significant difference in growth performance of the chickens among the dietary treatments. Average daily gain (ADG) was significantly higher (P<0.05) in birds on control diet and those on diets containing 25% CBSD than those on diets containing 50% and 75% CBSD. The Class of Cassava damage did not significantly (P>0.05) affect growth performance of the chickens. Chickens on control diet and those on 25% cassava inclusion had significantly higher final weight than chickens on 50% and 75% levels of cassava inclusion. Feed conversion ratio (FCR) was similar in all classes of root damage and at all levels of cassava inclusion.

Effect of level of cassava inclusion and class of root damage on carcass weight and tissue distribution

The final carcass weight, dressing percentages and weight of carcass components are shown in Table 5. Carcasses from birds on a control diet were significantly heavier than all other carcasses in the test diets (P<0.05) whereas those on 75% cassava inclusion were significantly lower than other treatments. A similar trend was observed for all carcass components i.e. thigh, breast and drumstick. The class of root damage had no significant effect on carcass weight, dressing percentage and weights of all carcass components.

Discussion

Chemical composition of the experimental diets

The diets compounded for this experiment were designed to supply at least 12.55MJ/kg of ME and CP of between 18-20% and these are common values employed in feed formulations. Using cassava to replace maize was expected to reduce the CP level in the diets as cassava is known to be poor in protein. To adjust for such reduction soybean was added. Analysis of the diets indicated that all the formulations were within the recommended levels of ME 11.65- 12.68MJ/kg and CP 180-190g/kgDM) for such type of birds, making the diets fairly comparable.

Effect of levels of cassava inclusion and of root damage on voluntary feed intake

The total feed intake ranged from 3.7 to 5.4 kg for the whole period of the experiment which is equal to an average of 88 g to 128 g per bird per day. This level of intake was within the range reported by Filmer–Flockman, (2010). The total intake was highest on control and 25% CL1, CL2 and CL3 and low on 50 and 75% of cassava inclusion. This high intake is likely to be associated with the form of the diets. The more cassava meal added to the diet the dustier the diet became (Tewe and Egbunike, 1992). Furthermore, the dust from cassava can cause respiratory problems thus reducing voluntary intake and hence the performance of the birds. The level of root damage did not seem

Table 3: Effect of levels of cassava inclusion and of root damage on voluntary feed intake g/bird/day

	Level of Cassava inclusion										
	25%			50%			75%				
	Class of Damage			Class of Damage			Class of Damage				
	1	2	3	1	2	3	1	2	3	Control	Pr > F
WK 3	71.71±5.43a	69.56±4.73a	58.99±2.38b	48.12±11.50c	63.25±5.06b	63.25±5.06b	51.89±2.45c	49.27±4.38c	50.47±18.82c	75.79±8.88a	0.0025
WK4	89.51±1.95a	83.26±1.76b	77.95±2.94b	84.55±5.08b	81.78±6.75b	80.43±2.21b	80.15±6.01b	74.45±0.68c	78.45±7.34b	86.36±4.26a	0.0226
WK 5	141.55±12.57a	121.24±6.27b	109.54±5.97c	101.62±17.34d	123.91±14.70b	115.11±26.94c	94.70±18.56d	89.57±10.61d	115.02±41.38b	116.14±6.78b	0.1213
WK6	154.57±7.21a	151.02±2.91a	128.92±13.88b	142.86±8.09b	137.70±15.56b	133.99±5.75c	122.06±13.82c	124.32±12.90c	116.08±12.40d	163.35±7.550a	0.0004
WK 7	153.22±17.14a	141.80±15.47 b	126.64±9.55c	126.12±9.83b	140.19±10.13b	155.30±15.44a	133.52±13.80c	101.28±52.28d	119.61±5.93d	148.98±22.73a	0.1181
WK 8	171.32±23.73a	98.30±10.72d	150.51±6.27b	122.72±16.07c	83.78±10.69d	92.57±5.92d	88.17±3.62d	101.49±17.39d	138.96±8.07c	178.76±5.98a	<.0001
AVFI	130.31± 8.46a	110.86±3.32b	108.76±5.01b	104.33±2.20c	105.10±7.02c	105.31±4.42c	90.06±14.71d	90.06±14.71d	103.10±4.90c	128.23±6.53a	0.001

WK= Voluntary feed intake per bird per day from week 3 to week 8, AVFI = Average voluntary feed intake; a-d = means bearing different letters within the row differs significantly at P<0.05

Table 4: Effect of levels of cassava inclusion and root damage on initial, final wt, ADG and FCR

	Level of Cassava inclusion										
	25%			50%			75%				
	Class of Damage			Class of Damage			Class of Damage				
Parameters	1	2	3	1	2	3	1	2	3	Control	Pr > F
Initial wt (g)	290±0.00^{a}	290±0.01^{a}	260±0.01^{b}	270±0.02^{b}	270±0.02^{b}	250±0.02^{c}	250±0.3^{c}	250±0.01^{c}	250±0.03^{c}	290±0.02^{a}	0.0201
Wk8	920±0.03^{a}	920±0.01 ^{a}	830±0..02^{b}	830±0.03^{b}	850±0.06^{b}	810±0.04^{c}	730±0.07^{d}	740±0.04^{d}	760±0.05^{d}	900±0.03^{a}	<.0001
Final wt (g)	1450±0.01^{a}	1320±0.03^{b}	1310±0.04^{b}	1250±0.06^{c}	1250±0.11^{c}	1210±0.04^{c}	1090±0.10^{d}	1130±0.11^{d}	1180±0.05^{c}	1450±0.07^{a}	<.0001
ADG (g/d)	30.48±1.84^{a}	27.57±0.62^{b}	27.35±0.94^{b}	25.75±1.57^{c}	26.15±2.58^{b}	24.98±0.84^{c}	22.17±2.11^{d}	23.11±2.87^{d}	24.29±1.84^{c}	30.62±1.59^{a}	<.0001
FCR	4.27±0.02^{a}	4.02±0.05^{a}	3.97±0.06^{a}	4.06±0.16^{a}	4.03±0.13^{a}	4.21±0.05^{a}	4.29±0.04^{a}	3.88±0.17^{b}	4.24±0.01^{a}	4.19±0.01^{a}	<.0001

WK8 = weekly weight week 8, ADG = Average Daily Gain, FCR = Feed Conversion Ratio; a-d = means bearing different letters within the row differs significantly at P< 0.05

to influence the nutritional properties of the formulations.

Effect of levels of cassava inclusion and of root damage on growth performance

The low average daily gain (ADG) of the birds on 50% and 75% level of cassava inclusion were caused mainly by the effect of low intake. These diets had high amount of cassava which is known to suppress voluntary feed intake when offered in finely milled form. The low ADG was recorded despite equivalent levels of CP and energy density as was in the other diets. It has been suggested that when using cassava as source of energy pelleting could be a better option than milling (Tewe and Egbunike, 1992). The feed conversion ratio (FCR) was lower than what has been reported by other workers (Thornton, 2012; Best, 2011). At all levels of cassava inclusion, the FCR were shown to be at least half the expected value compared to similar diets reported by Hossain *et al.* (2014). However, the lower levels of CP in the diets compared to the levels reported by Ceballos *et al.* (2006) and Balagopalan *et al.* (1991) could account for the difference in FCR. It is generally known that at early stages of growth, broiler chickens tend to be more sensitive to low CP than low ME in the diet.

Effect of levels of cassava inclusion and of root damage on carcass and carcass components

The dressing percentage from this study was within the range of 60 to 70% for broiler chickens as reported by Dietas et al. (2008). The weight of carcass components and their relative distribution were within the range reported by Shahin *et al.* (2005). There were no significant differences among the diets on non-carcass relative distribution. Generally, chicken from the control group and those given 25%CL1, 25%CL2 and 25%CL3 gave higher drumstick, thigh and breast than both 50% and 75% CL1, CL2 and CL3. The difference observed can be attributed to the better intake and growth performance recorded in chicks under Control (CTR), 25%CL1, 25%CL2 and 25%CL3 diets.

Table 5: Effect of level of cassava inclusion and class of root damage on carcass weight and tissue distribution

	Level of Cassava inclusion										
	25%			50%			75%				
	Class of Damage			Class of Damage			Class of Damage				
Parameter	1	2	3	1	2	3	1	2	3	Control	Pr > F
Slaughter wt (g)	1726.67±145.28a	1665.00±210.40a	1561.67±281.81b	1476.67±182.28b	1521.67±226.49b	1498.33±127.50b	1340.00±268.48c	1356.67±248.97c	1433.33±168.25b	1871.67±189.89a	0.0010
Carcass wt (g)	1073.33±167a	1143.33±174a	1080.00±211a	1031.67±138a	1046.67±171a	1026.67±100a	925.00±196b	923.33±184b	1001.67±108b	1311.67±161c	0.0080
Dress-ing %	62.54±1.57b	68.50±2.43a	69.23±5.20a	69.81±1.37a	68.94±6.63a	68.50±2.55a	68.91±1.18a	67.95±2.85a	70.04±4.34a	69.96±1.87a	0.3677
BRwt g	145.59±25.36a	154.19±37.86a	150.48±9.03a	143.35±34.36a	155.6±40.26 a	140.75±32.49a	115.60±31.61b	124.06±38.34b	138.42±29.98b	177.16±33.64c	0.4892
DRSwt g	71.37±5.47a	75.15±12.84a	73.87±15.36a	73.96±13.87a	76.10±14.88a	81.98±6.87b	67.37±17.80a	62.17±16.45a	69.76±9.98a	89.22±2.39b	0.1051
THwt g	81.11±8.78a	91.18±14.18a	89.06±22.11a	81.62±12.79a	87.79±17.29 a	88.33±10.04a	68.30±21.22b	68.34±20.32b	75.19±7.29b	95.34±6.69	0.1005

BRwt = Breast weight, DRS = Drum stick weight, THwt = Thigh weight. a-c means bearing different letters within the row differs significantly at (P<0.05)

Conclusions

The findings from this study indicate that regardless of the class of severity of the root necrosis/ damage, ground CBSD afflicted cassava roots can conveniently be used to replace maize meal up to 25% inclusion level and achieve results similar to birds given conventional maize based diet. Thus farmers and livestock keepers could alternatively use CBSD roots to formulate poultry diets at least at lower inclusion levels instead of throwing them away and leading to total loss for cassava farmers. .

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