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Effects of Replacing Maize meal with Cassava meal (*Manihot esculenta*) on the Growth Perfomance of Japanese Quails (*Cortunix japonica*) in Malawi

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ABSTRACT

A 35-day study was carried out to evaluate the optimum dietary inclusion level of cassava meal in a partial replacement with maize on the growth performance of quail. Initially, 150 day-old quails were raised in the same cage for one week to allow acclimatization. On day eight, 140 quails were selected and randomly allocated to five treatments (0%, 10%, 20%, 30% and 40% cassava inclusion levels - CIL). Each treatment had four replicates of seven birds in a Completely Randomized Design. Variables measured included weekly feed intake, weekly body weight, weight gain, feed convention ratio (FCR), carcass weight and dressing percentage. Feed and water were provided ad libitum. There was no significant difference (p>0.05) on feed intake at 0%, 10%, 20% and 30% inclusion levels. The lowest feed intake (127g/bird) was recorded at 40% cassava inclusion compared to 209g/b, 207g/b, 202g/b and 189g/b at 0%, 20%, 30% and 10% inclusion levels, respectively. The weekly body weights and weight gain of quails showed no significant difference (p>0.05) at 0%, 10%, 20% and 30% CILs. Specifically, 30% inclusion level had significantly higher weight gain at p>0.05 significant level than the control. The most efficient FCR was calculated at 30% inclusion level. Feed intake and body weight gain at treatment 10%, 20% and 30% were not different from the control (0%). Results suggest that cassava meal can be included up to 30% in quail diets.

Key words: Cassava inclusion level, Carcass weight, Cortunix japonica, Feed Conversion Ratio, Feed intake, Weight gain.

RÉSUMÉ

Une expérience d'une durée de 35 jours a été conduite pour déterminer le taux optimal d'inclusion de farine de manioc dans l'alimentation de la caille (*Coturnix japonica*), en remplacement partiel de la farine de maïs. Au départ, 150 cailles d'un jour ont été élevées dans le même enclos durant une semaine pour s'acclimater aux conditions. Le huitième jour, 140 cailles ont été retenues et réparties de manière aléatoire en cinq traitements (0 %, 10 %, 20 %, 30 % et 40 % de farine de manioc) avec quatre répétitions de sept oiseaux chacune, selon un plan complètement randomisé (CRD). Les variables mesurées comprenaient la consommation alimentaire hebdomadaire, le poids corporel hebdomadaire, le gain de poids, l'indice de consommation (IC), le poids de carcasse et le rendement de carcasse. Eau et aliment étaient distribués à volonté. Aucune différence significative (p > 0,05) n'a été relevée pour la consommation alimentaire aux taux de 0 %, 10 %, 20 % et 30 %

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de substitution, alors que la consommation la plus faible (127 g/oiseau) est observée à 40 % d'incorporation, contre 209 g/o, 207 g/o, 202 g/o et 189 g/o aux taux de 0 %, 20 %, 30 % et 10 % respectivement. Les gains de poids hebdomadaires et les poids corporels n'ont pas significativement varié (p > 0,05) aux taux de 0 %, 10 %, 20 % et 30 %. Néanmoins, l'incorporation à 30 % a produit un gain de poids statistiquement plus élevé (à p > 0,05) que le témoin (0 %). Le meilleur indice de consommation a par ailleurs été enregistré à 30 % d'incorporation. Les résultats suggèrent qu'on peut incorporer jusqu'à 30 % de farine de manioc dans la ration alimentaire des cailles sans nuire à leurs performances de croissance.

Mots-clés : taux d'inclusion de manioc, poids de carcasse, *Coturnix japonica*, indice de consommation, consommation alimentaire, gain de poids

INTRODUCTION

Poultry production is one of the major livestock related farming activities in Malawi at both smallholder and commercial level. Unlike in ruminants which depend on pasture, feed comprises the highest proportion of cost in non-ruminants such as poultry ranging from 60 to 70% of the total production cost (Sibanda *et al.*, 2023). Similar to other countries, the largest and commonest proportion of feed comprises maize, an energy feed ingredient. However, maize is also the major staple food in Malawi thereby creating a food-feed competition especially in lean periods due to disasters like prolonged droughts (Safalaoh and Kavala, 2020). Chipeta and Bokosi (2013) reported that almost 70% of the population in Malawi rely on maize as a staple food.

Malawi has experienced a growing interest in commercial quail (Cortunix japonica) farming for meat and egg production (Mac *et al.*, 2022), with the quail population increasing by approximately 8% between 2022 and 2024. The 2023/24 Agricultural Production Estimates report a current quail population of 12,858,095 (Department of Animal health and Livestock Development, 2024).

Mature quails are currently sold at an average price of MK2000 ($1.14) each, either dressed or roasted. While livestock contributes 4.1% to the national GDP—52% of which comes from poultry—the specific contribution of quail farming remains unquantified (De Weerdt *et al.*, 2023). As part of the Government's strategy to enhance commercially viable poultry value chains (Department of Animal health and Livestock Development, 2021), quail farming is gaining traction due to its advantages, including minimal land and feed requirements, rapid growth, early sexual maturity (Kinyua, 2022), and a short incubation period of 17–19 days (Ainsworth *et al.*, 2010).

The popularity of quail farming has inadvertently increased the demand for poultry feed and associated ingredients such as maize. This is particularly so because currently in Malawi and other developed countries, quail producers feed their birds broiler and layer -based feeds due to lack of tailor formulated quail feed (Masenya *et al.*, 2021). This has also been reported in other countries like South Africa (Mnisi *et al.*, 2023). Considering the increasing demand for poultry food and maize which is also a staple food, it is now imperative that Malawi explores alternative sources of energy ingredients that can be used when formulating diets for broilers, layers and quails.

Cassava is a widely cultivated food crop in Malawi, consumed by approximately 30–40% of the population, primarily as a supplement to maize during periods of low harvest (Kanyamuka *et al.*, 2018; Masamba *et al.*, 2022). The country produces an estimated 5.6 million tons annually, contributing 3% of Africa's total cassava output (Adebayo, 2023; Nwokoro *et al.*, 2024). Despite its potential as an energy source, the application of cassava in poultry nutrition, particularly in quail diets, remains underexplored. Cassava, recognized for its drought resistance, is an available yet underutilized feed ingredient in Malawi

(Kawaye and Hutchinson, 2020). Incorporating bitter cassava in poultry diets could mitigate human-food competition by reserving maize for human consumption while expanding the feed resource base (Mnisi *et al.*, 2023). Given the rising cost of maize, exploring alternative energy sources such as cassava is essential. This study evaluated the effects of varying inclusion levels of cassava meal as a maize substitute on the growth performance and carcass yield of quails.

MATERIALS and METHODS

Experimental study site. The research was conducted at Bunda Small Animal Unit Farm, Lilongwe University of Agriculture and Natural Resources, Lilongwe, Malawi.

Experimental animals and experimental studyA total of 150 newly hatched quails were housed in an electric brooder cage supplied with infrared bulbs as a source of heat for the first week. In week two, 140 quails of almost similar weights were randomly allocated to five treatments comprising 0%, 10%, 20%, 30% and 40% cassava inclusion levels (CIL). Each treatment had four replicates with seven birds each in a Complete Randomized Design (CRD). Starter mash and fresh clean water were provided *ad libitum* throughout the experimental period.

Cassava Root and Diet preparations. The cassava tubers were bought from local vendors. The roots were peeled off then immediately soaked in water for seven days. Soaking was conducted in order to improve feeding value by reducing or removing cyanogenic compounds commonly present in cassava (Morgan and Choct, 2016). The soaked peeled cassava tubers were removed and sundried for 96hrs before grinding to pass through a 2mm sieve. The diet was formulated to contain 24% crude protein (Table 1).

Data collection. Treatment response variables were weekly body weights (g), feed intake (g) and final body weights (g) at 42 days of age when most quails reach maturity (Mussah, 2017). Total weight gain was calculated by subtracting the initial weight of each bird from the final bird weight at 42 days of age. Feed intake was calculated by subtracting the leftovers from the amount of feed provided on the previous day throughout the experimental period. Weekly feed intakes were added to get total feed intake.

Table 1. Ration Composition of Treatments

Ingredient (kg)	0%	10%	20%	30%	40%
Maize meal	42.67	30.93	19.81	8.68	2.4
Maize bran	4.67	3.44	2.2	0.96	0.2
Soyabean	40.92	43.28	45.64	48	50.37
Fish meal	8	8	8	8	8
Cassava	0	10	20	30	40
Salt	0.25	0.25	0.25	0.25	0.25
Premix	1	1	1	1	1
MCP	0.5	0.5	0.5	0.5	0.5
Lime	1.5	1.5	1.5	1.5	1.5
Methionine	0.5	0.5	0.5	0.5	0.5
Lysine	0.6	0.6	0.6	0.6	0.6
Calculated analysis					
Crude-Protein (g/kg)	24	24	24	24	24
Digestible Energy(Kcal/kg)	3680	3700	3720	3740	3760
Metabolizable Energy(Kcal/kg)	3120	3100	3080	3060	3040
CrudeFibre(g/kg)	3.45	3.6	3.76	3.91	4.06
Calcium (g/kg)	0.85	0.86	0.88	0.89	0.91
Phosphorus(g/kg)	0.61	0.59	0.57	0.56	0.54
Methionine (g/kg)	0.87	0.87	0.86	0.85	0.84
Lysine (g/kg)	1.89	1.92	1.92	1.98	2.02

MCP=Monocalcium phosphate

Feed Conversion Ratio (FCR) was computed by dividing the feed intake by the weight gain and presented as a ratio of feed consumed to weight gain. At 42 days of age, one bird was randomly selected from each treatment pen making a total of 4 birds per treatment for carcass yield evaluation. The birds were slaughtered after fasting for eight hours, weighed and decapitated using an ordinary knife. The birds were then placed in hot water (52ºC) and scalded for approximately two minutes. Plucking and evisceration (removal of intestines and giblets) was conducted manually. Eviscerated carcasses were then weighed to determine carcass weights and later expressed as dressing percentage by diving carcass weights by final liveweights.

Statistical Analysis All data obtained were subjected to one-way analysis of variance (ANOVA) of the Complete Randomized Design (CRD) using Genstat where the factor was the different inclusion level of cassava in the diet with.

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

Where Y_{ij} is the observation of the i^{th} treatment, µ is the overall mean, t_i is the varying cassava inclusion levels and e_{ij} is the random error.

RESULTS and DISCUSSION

Effects of CILs on total feed intake, weight gain and Feed conversion ratio (FCR). The results obtained showed that there was no significant difference (P>0.05) in the total feed intake and weight gain of birds at 0%, 10%, 20% and 30% CILs. However, feed intake for birds on 40% CIL was the least among the treatments and significantly different from the rest of the treatments (Table 2).

There was an observable trend in feed intake among quails as dietary inclusion levels (CIL) of cassava meal varied. Feed intake tended to increase from 10% CIL (189g) to 20% CIL (207g) and subsequently decrease from 30% CIL (202g) to 40% CIL (189g). These findings suggest that while moderate incorporation of cassava meal in quail diets, up to 20%, may positively impact feed intake, higher inclusion levels exceeding 30% could result in reduced intake. This phenomenon could be attributed to multifaceted factors such as palatability, nutrient composition, and the presence of anti-nutritional constituents inherent in cassava. Kanyinji and Moonga, (2014) proposed that while cassava exhibits low energy and protein content, the high fiber content might lead to nutrient dilution, prompting birds to increase feed intake to meet nutritional demands (Nassar *et al*., 2019). Moreover, it has been suggested that diets rich in fiber could elevate villus height in the intestinal wall, consequently enhancing nutrient absorption and thus potentially increasing feed intake (Tejeda and Kim, 2021). The increased feed intakes also agree with Odo and Nnadi, (2014) who reported increased feed intake and body weight as inclusion levels of cassava increased from 0 to 25%.

Table 2. Effects of CILs on the feed intake final weight, weight gain, feed conversion ratio, weight gain, carcass weight and dressing percentage

Treatment	0%	10%	20%	30%	40%	MS	P value
Feed intake(g)	209^b	189^b	207^b	202^b	127^a	6554	0.0028
Final-body weight (g)	177^b	172^b	176^b	182^b	142^a	991.6	<0.001
Weight gain(g/b)	155^b	154^b	155^b	159^b	123^a	991.6	<0.001
Feed Conversion Ratio(feed:gain)	1.35^c	1.23^b	1.34^c	1.27^b	1.03^a	0.13	<0.001
Carcass weight(g)	140^b	116^a	122^a	140^b	112^a	973.6	0.014
Dressing percentage (%)	78.8	68.2	68.7	76.5	78.6	151.2	0.179

**Means followed by the same subscript within the same column are not significantly different at alpha = 0.05*

The phenomenon of decreased feed intake at higher CIL levels (Table 2) has been documented in previous research. For instance, Kanyinji and Moonga, 2014 observed a decline in feed intake at 100% CIL. Additionally, the dustiness of cassava root meal has been linked to reduced feed intake (Omede *et al.*, 2018). Furthermore, the passage rate of cassava-based diets has emerged as a contributing factor. Chiwona *et al.* (2015) noted that cassava root meal tends to stay in the stomach for an extended duration, resulting in gut fill that acts as a hunger suppressant, thereby inhibiting further feed intake. Figure 1 shows that feed intake started to decline steeply beyond 30% CIL.

Results in Table 2 further indicate that quail diets with higher levels of cassava inclusion (40% CIL) demonstrate a superior feed conversion ratio (FCR) of 1.03 when compared to those with lower cassava inclusion levels (1.23 for 10% CIL, 1.34 for 20% CIL, and 1.27 for 30% CIL), as well as diets lacking cassava (0% CIL), which recorded an FCR of 1.29. However, no significant difference was noted between the10% and 30% CIL diets. Noteworthy, although a lower FCR indicates better feed utilization per unit weight gain in practice (Varkoohi *et al.*, 2010; Rodde *et al.*, 2020), the diets with the most favorable FCR based on weight gain were those with 10% CIL and 30% CIL. The trend on effect of CIL on feed conversion ratio is shown in Figure 2.

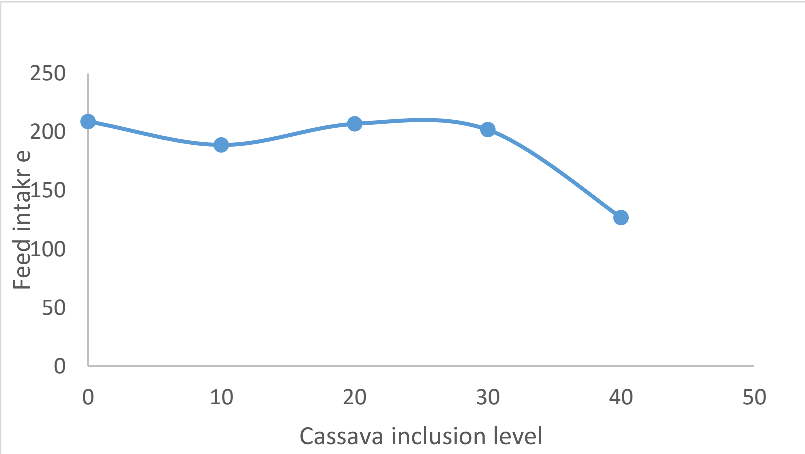

Figure 1. Correlation between cassava inclusion level and total feed intake (r = -0.7)

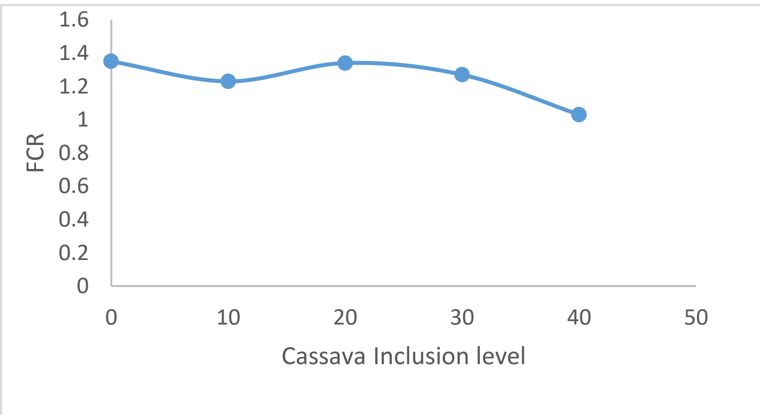

Figure 2: Correlation between cassava inclusion level and feed Conversion Ratio (FCR) (r = -0.7)

Effects of CILs on final body weights, weight gain and dressing percentage. The final body weight and body weight gain of birds subjected to 0%, 10%, 20% and 30% CILs were not significantly different (P>0.05) at day 42. These weights were also associated with higher feed intakes as reported in other studies (Kanyinji and Moonga, 2014) compared to the 40%CIL which had the lowest feed intake (Table 2).

The birds subjected to 40%CIL had significantly (P<0.05) lower final weight (142g) and weight gain (123g) than the rest of the treatments. data on weight showed an increase in body weight and body weight gain with an increase in the amount of CILs. Interestingly, the dressing percentage was not significantly different (P<0.005) among the four treatments. The correlation between CIL and weight gain presented in Figure 3 where there was drastic decrease in weight again beyond the 30% CIL. A similar trend was shown for carcass weight (Figure 4).

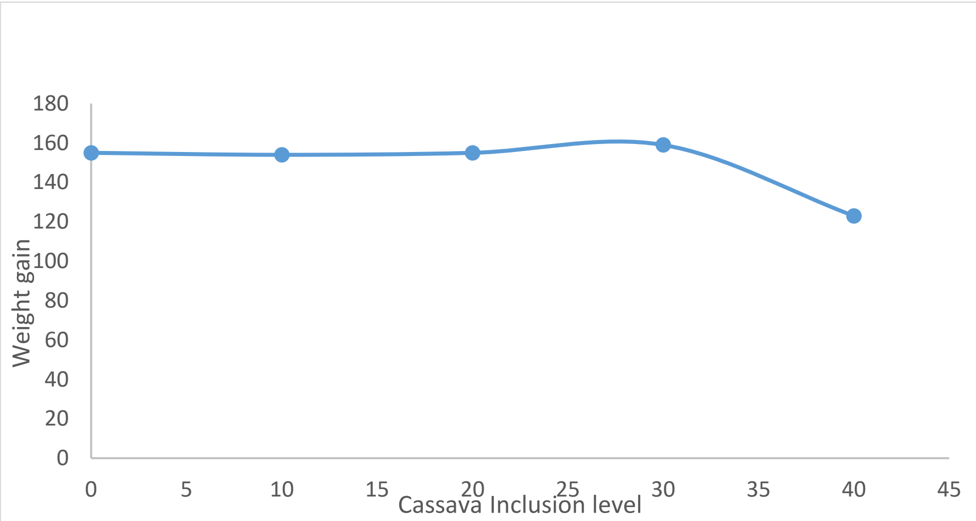

Figure 3. Correlation between cassava inclusion level and weight gain (r = -0.5)

Overall, the low body weight gains and poor feed conversion rate observed in this study for the high inclusion rate of cassava (40% CIL) can be attributed to poor and limited utilization due to factors such as high fibre, low energy content and the presence of anti-nutritional factors, primarily hydrocyanic acid (HCN) (Morgan and Choct, 2016).

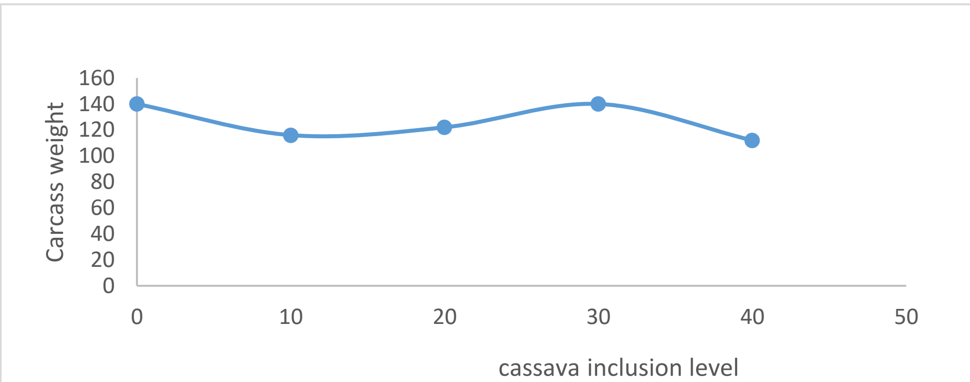

Figure 4: Correlation between cassava inclusion level and Carcass weight (r= -0.3)

CONCLUSION

This study evaluated how substituting maize meal with cassava meal at different inclusion levels impacts the growth and carcass characteristics of quails. The findings indicate that there was no significant difference in feed intake, body weight gain and carcass weight of quails at cassava inclusion levels of 10%, 20%, or 30% of quail diets. However, at a 40% cassava inclusion level, final liveweight, weight gain, and carcass weights decreased significantly when compared to the other treatments. The study suggests that cassava meal can replace maize as an energy source in quail diets up to 30%. It also recommends further research on aspects like feed digestibility and sensory evaluation of quail carcasses.

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STATEMENT OF NON-CONFLICT INTEREST

The authors declare that they have no competing interest.

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