



## UTILIZATION OF SWEET POTATO PEEL MEAL IN THE DIETS OF JAPANESE QUAILS (*Coturnix coturnix japonica*)

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### ABSTRACT

This study was conducted to investigate utilization of sweet potato peel meal (SPPM) as a dietary component in Japanese quails. Two hundred and twenty-five (225) mixed sex of two-week-old Japanese quails were used. The treatments consisted of five (5) diets to replace maize with SPPM at 0, 25, 50, 75, and 100%, designated as T1, T2, T3, T4, and T5, respectively, these were laid out in a Completely Randomized Design (CRD) replicated three times with 15 quails per replicate. The result revealed a significant ( $P < 0.05$ ) difference in final body weights, with T1, T2, and T3 exhibiting higher final weights compared to T4 and T5. Similarly, weight gain and feed conversion ratios (FCR) were more favorable at lower SPPM Level (up to 50%). Feed and water intake increased with higher SPPM Level. Dressed weight varied significantly ( $P < 0.05$ ), with T1 (0%) showing the highest dressed weight of 132.60 g, which was statistically similar to T2 (25%) and T3 (50%). The total feed consumption increased with higher SPPM level, while feed costs decreased, indicating potential economic benefits. Economic efficiency was highest (17.54%) in 0% and lowest (10.41%) in 100%. The study concluded that incorporating SPPM up to 100% in quail's diets promotes optimal growth performance, efficient feed utilization, and acceptable egg production without compromising economic returns. It is recommended that up to 50% SPPM can be included in the diets of growing quails to achieve optimal growth and feed efficiency.

**Keywords:** Quails, Utilization, Diets, Sweet Potato

### INTRODUCTION

Poultry production is rapidly expanding due to the increasing demand for meat and eggs (Ren *et al.*, 2020). Feed costs, accounting for about 70% of total expenses, are high due to seasonal shortages and competition with human consumption for conventional feed materials (Osuagwu and George, 2020; Yusuf *et al.*, 2020). To address this, exploring alternative, non-conventional feed ingredients is crucial, enabling farmers to select cost-effective options based on availability (Abdullahi *et al.*, 2023). Sweet potato (*Ipomoea batatas*), a herbaceous plant with a short generation interval and drought resistance, offers a promising alternative. It can be cultivated twice a year, ensuring year-round availability (Ibrahim and Olaniyi, 2018). Sweet potato is an important food crop globally, known for its high starch content and essential nutrients such as vitamin A, ascorbic acid, and B vitamins (Agubosi *et al.*, 2021). Nutritionally, sweet potato provides crude protein (36-46g/kg), crude fiber (38-70g/kg), and a metabolizable energy value of 11.25MJ/kg (Abdel-Hafeez *et al.*, 2018; Agubosi *et al.*, 2021). Potatoes are rich in biological active compounds like starch, dietary fibers, amino acids, vitamins, and phenolic compounds, are also potent sources of antioxidants (Calliope *et al.*, 2018; Mutter and Abbas, 2023). Potato peel often discarded is rich in natural antioxidants and bioactive compounds with antimicrobial and anticancer properties, making them valuable in functional food formulations (Sampaio *et al.*, 2021). Studies show that including purple sweet potato extract in broiler feed enhances growth rate, feed conversion ratio, and reduces blood



cholesterol and low-density lipoproteins (Nasoetion *et al.*, 2019). Sweet potato peel is high in energy and moderate in protein, they are suitable alternative to maize in poultry diets, offering potential as an energy and mineral source when properly processed (Agubosi *et al.*, 2021; Solomon *et al.*, 2020).

Japanese quails (*Coturnix coturnix japonica*), valued for their meat and eggs, and are significant in many cultures, especially in China and Japan. Increasing investment in quails farming, particularly in Nigeria, could enhance the nation's deficient animal protein intake (Bulus *et al.*, 2013; Babatunde *et al.*, 2016). However, commercial-scale quails farming in Nigeria faces challenges due to lack of comprehensive feeding data (Paca, 2020). Quails are economically important due to their small size, short generation interval, disease resistance, and high egg production. Despite their potential, their nutritional requirements, especially in tropical climates, are not well established. In Nigeria, quails diets typically require 24% crude protein for growth phase and 20% for production (egg or meat) phase, as recommended by NRC (1994). Babatunde *et al.* (2016) suggest that a diet of 26% crude protein and 3200 kcal metabolizable energy/kg supports optimal weight gain in Japanese quails. Nutritional recommendations vary, with crude protein levels between 18% and 28%, depending on the quail's age and growth phase (Woodard *et al.*, 1973; Lee *et al.*, 1977; Nwokedi *et al.*, 2010; Murakami *et al.*, 1993a). This study aims to examine the use of sweet potato peel meal as an energy source in the diets of Japanese quails.

## **MATERIALS AND METHODS**

### **Study area**

The research was carried out at National Veterinary Research Institute Poultry Farm unit Vom, Jos South local Government Area of Plateau State Nigeria located 28km. south of the State capital, Jos and occupies a land surface area of 1037 km<sup>2</sup>. The mean annual rainfall ranges between 131.75mm-146mm and the highest usually recorded in the month of July and August. The weather is always cold between the months of December and February due to the haematin wind.

### **Source and Processing of Sweet Potato Peel and Experimental Diets**

Sweet potato peel was sourced from fast food restaurants in Bauchi metropolis, Bauchi State, during the dry season. The peel was sun-dried after which it was winnowed to remove any foreign materials. A sample of the winnowed sweet potato peel was then milled at livestock investigation department (LID) feed mill Vom, and used for chemical analysis. Other feed ingredients were sourced from Jos South, Plateau State. Sun-dried sweet potato peel meal (SPPM) and other feed ingredients were mixed to produce experimental diets containing 24% crude protein. Five experimental diets were formulated to replace 0, 25, 50, 75, and 100% maize with SPPM, designated as T1, T2, T3, T4, and T5, respectively. The calculated crude protein content ranged from 23.67% to 24.00%, and the metabolizable energy ranged from 2900 to 3000 kcal, cross and proximate composition of the experimental diet were shown in Table 1 and 2.

### **Treatments and Experimental Design**

The treatments consisted of five (5) diets to replace maize with SPPM at 0, 25, 50, 75, and 100%, designated as T1, T2, T3, T4, and T5, respectively, these were laid out in a Completely Randomized Design (CRD) replicated three times with 15 quails per replicate

### **Data Collection**

The initial body weights of the chicks were taken as the group weight for each replicate prior to the distribution to their respective treatment groups. The final weight, daily feed intake (DFI) daily weight change (DWC) and feed conversion ratio (FCR). The daily feed intake was

obtained by difference between quantity of feed offered and the left-over, retrieved the following morning. Daily weight gain was determined by difference between two consecutive weighing carried out on weekly basis while feed conversion ratio was computed using the relationship between daily feed intake and daily weight gain. Feed intake was calculated on the difference between the quantities of feed.

Similarly, at the end of the feeding trial, four (4) birds with comparable body weight were randomly selected per replicate for carcass and organ weight evaluation. The selected birds were starved for 12 hours prior to slaughter while water was provided. The birds were weighed to compare live and slaughter weights. The data on hot carcass and organ weights were recorded and expressed in gram. Dressing percentage was calculated as percentage of live weight excluding edible offal. Finally, the carcass were partitioned in to breast, wing, and drumsticks with thigh, neck and back yields and weighed and expressed in gram based. Dressing percentage (DP) was obtained by weighing the carcass relative to the live weight of each bird and expressed in percentage (%) as shown below.

$$DP = \frac{\text{Carcass weight}}{\text{Live Weight}} \times 100 \quad \dots (1)$$

**Table 1:** Composition of Experimental Diets

<b>Ingredients</b>	<b>Diet1 (0%)</b>	<b>Diet2 (25%)</b>	<b>Diet3 (50%)</b>	<b>Diet 4 (75%)</b>	<b>Diet5 (100%)</b>
Maize	41.48	31.12	20.74	10.36	0.00
SPPM	0.00	10.36	20.74	31.12	41.48
GNC	40.48	40.48	40.48	40.48	40.48
Wheat offal	7.00	7.00	7.00	7.00	7.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Palm oil	3.00	3.00	3.00	3.00	3.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.00	1.00	1.00	1.00	1.00
Salt	0.24	0.24	0.24	0.24	0.24
Premix	0.24	0.24	0.24	0.24	0.24
Lysine	0.12	0.12	0.12	0.12	0.12
Methionine	0.12	0.12	0.12	0.12	0.12
<b>Total</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>	<b>100.00</b>
M.E. (kcal/kg)	3090.37	3044.84	3021.72	3010.65	3000.52

SPPM: sweet potato peel meal, GNC: groundnut cake

**Table 2:** Proximate Composition of Experimental Diets

<b>Ingredients</b>	<b>Diet1 (0%)</b>	<b>Diet2 (25%)</b>	<b>Diet3 (50%)</b>	<b>Diet 4 (75%)</b>	<b>Diet5 (100%)</b>
Dry matter	89.70	91.20	90.10	93.47	90.41
Organic matter	78.10	83.40	80.60	81.20	79.85
Ash	11.60	7.80	9.50	12.27	10.56
Crude protein	24.61	23.89	23.50	24.61	23.90
Crude fibre	4.61	5.62	4.72	5.61	4.52
Ether extract	8.89	10.10	9.22	8.91	8.54
Av. Phosphorus	0.41	0.47	0.46	0.49	0.39
Lysine	1.60	1.29	1.43	1.28	1.39



### **Economic Analysis of Sweet Potato Peel**

To evaluate the economic benefit of using sweet potato peel as an energy source in the diet of quail's, the following indices were used: total feed intake, cost of feed per gram, total egg production, and cost of eggs. The economic analysis was performed using the following formula

$$\text{Cost of feed per gain (CFPG)} = \frac{\text{Total cost of feed intake}}{\text{Total feed consumed in grams}} \quad \dots 2$$

### **Proximate Analysis**

proximate analysis was carried out on the feed samples to determine the dry matter (DM), organic matter (OM), crude protein (CP), crude fibre (CF), ether extract (EE), ash and nitrogen free extract (NFE) of the experiment diets used in both growing phase and laying phase of the experiment.

### **Statistical Analysis**

The data collected were subjected to analysis of variance (ANOVA) using suitable statistical software (2007). Significant differences among treatment groups were determined using Duncan's multiple range test (DMRT) Duncan (1995).

## **RESULTS AND DISCUSSION**

### **Growth Performance of Japanese Quails Fed Varying Levels of Sweet Potato Peel Meal**

Table 3 presented result of growth performance of Japanese quails fed diets containing varying levels of sweet potato peel meal (SPPM). Parameters measured included final body weight, total weight change (TWC), daily weight change (DWC), total feed intake (TFI), daily feed intake (DFI), total water intake (TWI), daily water intake (DWI), and feed conversion ratio (FCR). The result a significant ( $P < 0.05$ ) difference in all parameters measured. The result further indicated a significant effect of SPPM on growth and feed efficiency of Japanese Quails. Final weights, were significantly higher with value of 153.61 in T1 (0% SPPM), 150.00 in T2 (25% SPPM), and 153.03 in T3 (50% SPPM) compared to 137.52 in T4 (75% SPPM) and 130.70 in T5 (100% SPPM), suggesting that higher SPPM levels may reduce nutrient density and hinder growth. This pattern is consistent with the findings of Akintunde *et al.* (2018), though it contrasts with Malik *et al.* (2018), who observed no significant differences in quails fed cassava peel meal. Total weight change (TWC) and daily weight change (DWC) followed a similar trend, with T1, T2, and T3 showing significantly higher gains, indicating that higher SPPM levels (75% and 100%) may not provide adequate nutrients. This aligns with the findings of Esonu *et al.* (2011) and Akintunde *et al.* (2018), though it differs from Malik *et al.* (2018), who reported no significant differences in weight gain across dietary treatments. Total feed intake (TFI) and daily feed intake (DFI) increased with higher SPPM levels, likely due to the lower nutrient density of the diets. This compensatory increase in feed intake is supported by Adeyemi *et al.* (2014) and aligns with Akintunde *et al.* (2018), though the values are lower than those reported by Malik *et al.* (2018). Water intake also increased with higher SPPM levels, which Andriani *et al.* (2012) attributed to the higher fiber content of the diets. The feed conversion ratio (FCR) significantly increased with higher SPPM levels, indicating poorer feed efficiency. T1 (0% SPPM) had the lowest FCR, reflecting more efficient feed utilization compared to T5 (100% SPPM), which had the highest FCR. This finding aligns with Onimisi *et al.* (2021), though the FCR values are lower than those reported by Malik *et al.* (2018) and within the range observed by Akintunde *et al.* (2018).



**Table 3:** Growth Performance of Japanese Quails Fed Varying Levels of Sweet Potato Peel Meal to replace maize as a source of energy

Parameters	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
Initial Weight (g/b)	36.31	35.25	36.12	33.52	36.58	1.27
Final Weight (g/b)	153.61 <sup>a</sup>	150.00 <sup>a</sup>	153.03 <sup>a</sup>	137.02 <sup>b</sup>	130.70 <sup>b</sup>	2.85*
Total weight change (g/b)	117.30 <sup>a</sup>	114.75 <sup>a</sup>	116.91 <sup>a</sup>	103.49 <sup>b</sup>	94.11 <sup>c</sup>	2.63*
Daily weight change (g/b)	4.19 <sup>a</sup>	4.17 <sup>a</sup>	4.09 <sup>a</sup>	3.69 <sup>b</sup>	3.36 <sup>c</sup>	0.94*
Total feed intake (g/b)	354.57 <sup>d</sup>	375.48 <sup>c</sup>	405.72 <sup>b</sup>	425.04 <sup>ab</sup>	433.41 <sup>a</sup>	9.33*
Daily feed intake (g/b)	12.66 <sup>b</sup>	13.41 <sup>b</sup>	14.49 <sup>a</sup>	15.18 <sup>a</sup>	15.07 <sup>a</sup>	0.41*
Total water intake (g/b)	1503.81 <sup>c</sup>	1445.19 <sup>d</sup>	1555.49 <sup>bc</sup>	1568.45 <sup>ab</sup>	1623.16 <sup>a</sup>	25.81*
Daily water intake (g/b)	42.96 <sup>b</sup>	41.29 <sup>d</sup>	44.44 <sup>bc</sup>	44.81 <sup>ab</sup>	46.38 <sup>a</sup>	0.73*
Feed conversion ratio	3.02 <sup>a</sup>	3.27 <sup>b</sup>	3.47 <sup>b</sup>	4.11 <sup>c</sup>	4.62 <sup>d</sup>	0.11*

<sup>a,b,c,d</sup> = Means on the same row with different superscripts were significantly ( $p < 0.05$ ), SEM: standard error of the mean, \*: significant different.

### Carcass and Organs Characteristics of Japanese Quails Fed Varying Levels of Sweet Potato Peel Meal

Results of carcass characteristics of Japanese quails fed varied Levels of sweet potato peel meal is presented in Table 4. The result showed no significant difference in most of the parameters measured, except for live weight (g), slaughter weight (g), dressing weight (g), back cut % lungs, small and large intestine that significant ( $P < 0.05$ ) variations were observed. The variations in this study can be linked to differences in nutrient composition and digestibility of the diets. The high fiber content in SPPM diets reduces nutrient absorption and energy availability, which negatively impacts growth performance and carcass yield (Nworgu *et al.*, 2014). As shown in the table, the live and slaughter weights significantly decreased as the SPPM level increased, with T1 (0% SPPM) showing the highest weights. This trend can be attributed to the reduced nutrient density in higher SPPM diets, leading to lower growth performance; this is in agreement with the findings of Ayanwale *et al.* (2019) and Ijaiya *et al.* (2024). The dressing weight also decreased with increasing SPPM levels, with T1 showing the highest values, indicating better overall growth and muscle development. The consistency in dressing percentage across treatments suggests that higher SPPM levels negatively impact dressed weight due to lower energy density and nutrient availability ((Esonu *et al.*, 2011). Interestingly, while the percentage of the head remained stable, the thigh and drumstick percentages varied slightly, with T5 (100% SPPM) showing the highest values, indicating that these parts may be less influenced by diet compared to overall body weight. This stability is in line with findings by Malik *et al.* (2018) and Aliyu *et al.* (2021), who reported similar results with cassava peel meal and sorghum. The breast and back cuts showed variations across treatments, reflecting differences in muscle growth and fat deposition due to the different SPPM levels. Higher back cut percentages in T5 suggest that this part may be more affected by SPPM levels, a finding that aligns with Bonos *et al.* (2010). The increased liver weights in some treatments might indicate stress or detoxification efforts due to anti-nutritional factors in SPPM, while variations in gizzard weights could reflect the impact of dietary fiber on digestive organ development, consistent with Malik *et al.* (2018) and Aliyu *et al.* (2021). Additionally, the differences in lung and small intestine weights across treatments suggest potential respiratory distress or changes in gut microbiota composition or digestive function due to higher SPPM levels. These findings align with Shalome and Uwadiae (2021), who noted that

high-fiber diets could affect gut health and nutrient absorption, leading to increased gut fill and weight. The higher large intestine weight in T4 (75% SPPM) may result from greater fiber fermentation and water retention in the hindgut, a trend observed by Maggawa *et al.* (2020).

**Table 4:** Carcass and Organs Characteristics of Japanese Quails Fed Varying Levels of Sweet Potato Peel Meal to Replace Maize in Diet

Parameters	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
Live Weight (g)	192.96 <sup>a</sup>	170.31 <sup>b</sup>	170.91 <sup>b</sup>	162.75 <sup>b</sup>	159.13 <sup>b</sup>	7.69*
Slaughter weight (g)	186.96 <sup>a</sup>	165.53 <sup>b</sup>	161.70 <sup>b</sup>	159.12 <sup>b</sup>	156.08 <sup>b</sup>	6.16*
Dressing Weight (g)	132.60 <sup>a</sup>	117.65 <sup>ab</sup>	121.80 <sup>ab</sup>	111.65 <sup>b</sup>	106.50 <sup>b</sup>	7.13*
Dressing%	68.67	69.09	71.54	68.57	66.93	3.83ns
Head %	3.26	3.40	3.32	3.63	3.64	0.17 ns
Thigh%	7.35	7.46	6.89	7.69	7.81	0.44 ns
Neck%	5.35	5.66	4.99	5.82	4.65	0.53 ns
Drumstick %	5.27	5.53	4.93	5.34	5.54	0.34 ns
Breast cut %	21.86	21.76	20.19	21.20	21.65	0.97 ns
Back cut %	11.60 <sup>b</sup>	10.98 <sup>b</sup>	10.61 <sup>b</sup>	11.13 <sup>b</sup>	13.30 <sup>a</sup>	0.76*
Wing cut %	5.47	5.45	4.79	5.47	5.65	0.46 ns
Shank %	1.63	1.69	1.48	1.81	1.79	0.19 ns
Liver %	3.04	3.17	2.45	2.97	3.06	0.38 ns
Gizzard %	2.86	3.31	2.93	3.67	3.19	0.34 ns
Heart %	0.68	0.69	0.55	0.66	0.66	0.98 ns
Lungs %	0.97 <sup>ab</sup>	0.90 <sup>ab</sup>	0.69 <sup>b</sup>	0.92 <sup>ab</sup>	0.99 <sup>a</sup>	0.11*
Kidney %	0.56	0.71	0.43	0.62	0.74	0.18 ns
Small intestine %	2.88 <sup>ab</sup>	3.04 <sup>ab</sup>	2.53 <sup>b</sup>	3.25 <sup>ab</sup>	3.87 <sup>a</sup>	0.50*
Large intestine %	1.39 <sup>b</sup>	1.24 <sup>b</sup>	1.61 <sup>b</sup>	2.31 <sup>a</sup>	1.50 <sup>b</sup>	0.21*
Testes %	2.75	2.47	3.19	2.64	2.81	0.52 ns
Ovaries %	3.30	3.06	2.73	3.60	3.43	0.61 ns

abc = Means on the same row with different superscripts were significantly ( $p < 0.05$ ), SEM standard error of means, \*significant different, NS: no significant different

### Cost Benefits of Japanese Quails Fed Varying Level of Sweet Potato Peel Meal

The cost benefit of feeding SPPM is presented in Table 5. The results of Japanese quails fed diets containing varying Level of sweet potato peel meal (SPPM) exhibited total feed intakes ranging from 16.23 kg (T1, 0% SPPM) to 19.13 kg (T4, 75% SPPM) during the growing phase, with feed intake per day per bird increasing alongside higher SPPM inclusion Level in table 4. This trend aligns with the findings of Edache *et al.* (2021) and Angbulu *et al.* (2019), who similarly reported increased total feed intake and feed cost per kilogram with the inclusion of alternative feed ingredients in poultry diets. Moreover, the cost of feed consumed per day decreased with rising SPPM Level, from ₦6.24 in T1 to ₦5.56 in T5 in table 4. This reduction in feed cost echoes the results of Obadire *et al.* (2022), who found that alternative feed ingredients in broiler diets effectively reduced overall feed costs. When comparing the present study (table 4) with the results reported by Akintunde *et al.* (2017), it becomes evident that the inclusion of SPPM led to more stable feed costs per gain, akin to the consistent feed cost per gain reported in Akintunde *et al.* (2017)'s study across various dietary treatments. However,



the lower absolute values of feed costs per gain observed in this study (table 4) suggest that SPPM could serve as a cost-effective alternative feed ingredient. Additionally, the cost per gram of feed decreased from ₦0.484 in T1 to ₦0.37 in T5, further demonstrating that higher inclusion Level of SPPM contributed to reduced feed costs. This observation is in agreement with the findings of Obadire *et al.* (2022) and Angbulu *et al.* (2019), who also noted that alternative feed ingredients could lower feed costs without significantly affecting feed conversion ratios.

**Table 5:** Cost Benefits of Japanese quails Fed Varying Level of Sweet Potato Peel Meal

Parameters	T1 (0%) SPPM	T2 (25%) SPPM	T3 (50%) SPPM	T4 (75%) SPPM	T5 (100%) SPPM
Total feed consumed (g)	16233	16895.0	18257.41	19126.8	18996
Cost of feed consumed (₦)	7866.44	7699.16	7790.79	7604.36	7001.49
Total feed intake per day (g)	579.75	603.39	652.05	683.1	678.42
Cost of total feed intake per day (₦)	280.94	274.97	278.24	271.58	250.05
Feed consumed per bird per day (g)	12.9	13.41	14.5	15.2	15.1
Cost of Feed per Gram (₦)	0.484	0.455	0.455	0.40	0.37
Cost of FI/b/day (₦)	6.24	6.11	6.18	6.04	5.56

## CONCLUSION AND RECOMMENDATION

From result of this study, it was concluded that sweet potato peel meal (SPPM) can replace up to 100% maize in the diet of quails without any adverse effect in terms of growth performance, egg production, carcass quality and ensued a reduction in the total cost of production. Based on the result of this study show that, sweet potato peel meal should be incorporated at up 50% in the diets of Japanese quails to improve growth and carcass quality and replace maize in the diets of Japanese quails at level up 100% to reduce costs.

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