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PERFORMANCE OF GROWING JAPANESE QUAILS (*COTURNIX COTURNIX JAPONICA*) FED DIFFERENT LEVELS OF PEELED COOKED SUN-DRIED SWEET POTATO (*IPOMEA BATATAS*) MEAL DIETS

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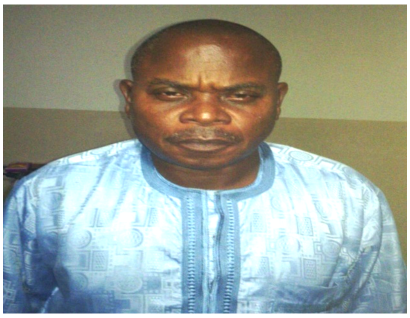

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ABSTRACT

A six –week feeding trial was set up to investigate the effect of feeding peeled, cooked, sundried sweet potato tuber meal on growth parameters and digestibility of nutrients by Japanese quail chicks. Five isonitrogenous (25%CP) diets were compounded. The control diet (A) had zero sweet potato tuber meal. In the other four diets (B, C, D, and E), 25, 50, 75 and 100% of maize (respectively) was replaced by peeled, cooked, sundried sweet potato tuber meal. Sixty birds were randomly assigned to each diet in a completely randomized design. The diets were replicated three times with twenty birds per replicate. Feed and water were given *ad libitum*. Parameters measured were feed intake, water intake, body weight gain, feed conversion ratio, and feed cost/gain. Others were protein intake and energy intake in the course of the study. Feed intake was significantly (p<0.05) lower on diet C (14.05g/bird/day) than on diets D (14.87 g/bird/day) and E (14.79g/bird/day). Other differences were not significant. Water intake was significantly (p<0.05) higher on diet D (27.40ml/bird/day) than on diets A (23.77 ml/bird/day), B (24.01 ml/bird/day) and C (24.66ml/b/d). Other differences were not significant. Protein intake was significantly (p<0.05) higher on diet D (3.72g) than on diets A (3.55g), B (3.54g) and C (3.51g). Differences between diets D and E were not significant. None of the other parameters (weight gain, feed conversion ratio, feed cost/gain, energy intake) measured in the course of the study differed significantly (p>0.05) from the control. Apparent digestibility of dry matter was significantly better (p<0.05) by birds on diet A (control) than by birds on the sweet potato meal diets. Digestibility of crude protein was significantly better (p<0.05) by birds on diet C than by those on diets A, B and E. Ether extract digestibility was significantly better by birds on diet E than by those on the control and other sweet potato diets. There was one hundred percent survivability as none of the birds died in the course of the study. Results of this study show that peeled cooked sundried sweet potato can completely replace maize in the diet of quail chicks without adverse effects on performance or on digestibility of nutrients.

Key words: Japanese quail, sweet potato, feed intake, energy intake, digestibility

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INTRODUCTION

Japanese quails are small-bodied birds, weighing about 180 g at maturity. The quail belongs to the class Aves, order Galliformes, family Phasianidae and kingdom Animalia [1]. They are prolific [2] and hardy birds which are low in body fat and cholesterol but high in body protein content. The eggs weigh on average 10 g [3, 4] and usually hatch by the 17th day of incubation [3]. This fast-growing nature of this farm animal makes it the panacea for increasing animal protein availability to the growing human population.

There is increasing competition between man and livestock for available feedstuff for food. Cheaper and emerging feed sources seem to be the panacea for the rising feed cost. There is a need to exploit cheaper energy sources in order to replace maize for animal feed production. In Nigeria, sweet potato is cheaper to produce than grain in some regions of the country.

Sweet potato meal can substitute for maize in diets for broiler starter and finisher [5] at 27% and 30% respectively but higher level resulted in wet droppings. Maize was replaced at 100% dietary level with sweet potato in diets of broiler chicks [6]. According to this report [6], measurements taken were feed intake, weight gain, feed efficiency, dressing percentage, and digestibility and it was recommended that not more than 75% of maize should be replaced by sweet potato.

There were reports of a consistent drop in weight gained as the quantities of sweet potato increased in the diet for broilers [7]. The feed became increasingly dusty with increasing sweet potato content and this may have been responsible for the drop in weight gain of the broilers. However, the birds were not predisposed to anaemia or any health threat [7]. However, as observed previously [8], data on the use of sweet potato for non-ruminant animals are limited. Cooking did not significantly affect the utilization of energy [9] but increased the digestibility of the nutrients [9,10]. The objective of this study, therefore, was to investigate the effect of feeding peeled, cooked, sundried sweet potato tuber on the growth performance and digestibility of nutrients by Japanese quail chicks.

MATERIALS AND METHODS

Source and processing method of sweet potato tuber

The white-flesh sweet potato tuber used in this study was purchased from Jos and from a border market between Plateau and Kaduna States. The sweet potato tubers were cleaned and processed as follows:

Sweet potato tubers were peeled, sliced to about 3mm, cooked for 20 minutes (at 100^o C) and sun-dried for seven days during the dry season of no rain.

The cooking was done by pouring the sliced sweet potato tubers into boiling water and leaving them to boil for 20 minutes.

The processed sweet potato tubers were milled using a hammer mill fitted with an 8 mm sieve for incorporation into experimental diets. The diets were analyzed for proximate and chemical composition using procedures outlined by AOAC [11].

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Diets Formulation

Five 25% crude protein (CP) isonitrogenous experimental diets were formulated. The first diet contained 0% of sweet potato which is the control diet tagged A. The other four diets where peeled sundried sweet potato replaced maize at 25, 50, 75 and 100% were tagged B, C, D, and E respectively. The ingredients and analyzed nutrient composition of the experimental diets are presented in Table 1.

Experimental birds

Three hundred unsexed day-old quail chicks were purchased from the Poultry Department of the National Veterinary Research Institute, Vom. They were healthy, and uniform in weight and size.

Housing and experimental procedure

The birds were housed in a standard poultry brooding house with deep litter partitions using wire mesh to allow for adequate ventilation and spaced 75 sq cm per bird as recommended [4]. The birds were randomly allotted to five (5) dietary treatment groups at sixty (60) chicks each in a completely randomized design. The treatments were replicated three times with twenty (20) chicks each. Each replicate group of chicks was weighed at the start of the feeding trial and thereafter weighed weekly to monitor the growth response over time. Cool, clean drinking water and experimental diets were provided *ad libitum* for the study period of six weeks.

Data collection

Feed intake, water intake, body weight gain, energy intake, and protein intake were measured in the course of the study. From the feed intake and weight gain, feed conversion ratio (FCR) was calculated. Feed cost per kilogram feed and feed cost/gain was calculated using the prevailing market prices around Jos. From the weight gain, energy intake and protein intake, energy efficiency ratio and protein efficiency ratio were derived.

$$\text{FCR} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Protein intake was calculated by multiplying feed consumed by the protein content of the diet. Feed cost/gain was calculated by multiplying values for feed conversion ratio by the unit cost of the diet. Energy intake was calculated by multiplying feed consumed by the energy content of the diet.

Data collected were subjected to one-way analysis of variance (ANOVA) as described in Steel and Torrie [12] and means were separated using Duncan's Multiple Range Test [13] at ($p<0.05$).

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Apparent nutrient digestibility study

At the end of the fifth week of the experiment, four birds (4) per replicate whose live weights were as close as possible to the mean live weight for the treatment were used for digestibility trial. Four birds from each replicate were placed in a digestibility crate and given a known quantity of feed that they consumed per day. They were fasted overnight and placed on the experimental diets for seven days. Faecal collection was carried out for the seven days. The faeces collected were oven-dried for a period of 18 hours at a temperature of 105^0C and weighed daily. At the end of the collection period, the faecal samples collected from each replicate group were bulked, milled and thoroughly mixed to obtain a homogenous mixture. Samples were then taken and analyzed for proximate composition according to the AOAC outlined methods [11].

RESULTS

The result of analysis of peeled, cooked, sundried sweet potato showed the mean value for dry matter as 95.50% while crude protein as analyzed was 5.45%. Values for ether extract, ash, crude fibre, and nitrogen-free extract were 6.43, 4.99, 6.43 and 72.20%, respectively.

The performance response of quail birds fed on graded levels of peeled and cooked sundried sweet potato tuber meal is presented in Table 2. Final body weight, weight gain, feed conversion ratio feed cost/kg gain and energy intake were not significantly (p>0.05) affected by the dietary levels of peeled cooked sundried sweet potato meal. Final body weight was lowest in birds fed on diet B (141.67g/bird) and highest for those on diet D (148.83g/bird). Body weight gain was lowest for birds fed diet on B (3.85g/bird/day) and highest for those on diet D (4.06g/bird/day). Feed conversion ratio was similar but numerically lowest for birds on diet A (3.29) and highest on those on diet E (3.61). Feed cost per kg gain observed among the dietary treatments showed non-significant (P>0.05) differences among the dietary treatments. The cost of feed per unit gain was interestingly similar (₦240/kg gain or 1.46USD/kg gain) for each of the diet (A, B, C, D, and E.). Energy intake varied between 36.38kcal/g (diet E) and 37.23kcal/g (diet A). Feed intake, water intake, protein intake, and energy efficiency ratio were significantly (P<0.05) affected by the diets. Feed intake were similar for birds fed diets A (14.21g/bird/day), B (14.17 g/bird/day), D (14.87g/bird/day) and E (14.79g/bird/day) and significantly (p<0.05) higher than those on diet C (14.05g/bird/day). Other differences were not significant. Water intake was significantly higher for birds on diet D (27.40ml/bird/day) than those on diets A (23.77g/bird/day), B (24.01 g/bird/day) and C (24.66ml/bird/day). The differences between D and E were not significant. . Protein intake followed the same pattern with water intake. It was significantly higher for birds on diet D (3.72g) compared to those on diets A (3.55 g), B (3.54 g) and C (3.51g/bird), respectively.

Apparent nutrient digestibility by quail birds presented in Table 3 showed that dry matter digestibility was significantly better (P<0.05) on the control than those on the sweet potato diets. Crude protein and ether extract digestibility, on the other hand, were better on the sweet potato diets than on the control. Crude protein digestibility was significantly (P<0.05) higher on diet C (57.73%) than on diets A (50.29%), B (53.84%) and E (51.45%). Differences in apparent nutrient digestibility between birds on diets C and D

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were not significant. Ether extract digestibility on diet E (81.22%) was significantly higher ($P<0.05$) than on diets A (67.31%), B (61.86%), C (67.61%) and D (65.61%). Other differences were not significant.

DISCUSSION

The ash content was between 3.41% and 4.10% and was higher than the 2.6% to 2.8% reported by Maphosa *et al*. [14] but lower than the values of 5.39% -6.07% obtained in the diet for broilers reported by Panigrahi *et al*. [15]. The crude fibre content of the feed (3.81– 4.32%) is higher than 2.94% – 3.00% reported by Maphosa *et al*. [14] but compared favourably to 4.45% documented by Panigrahi *et al*. [15]. The ether extract content (4.02% – 4.84%) is higher than 1.50% – 1.90% reported by Maphosa *et al*. [14] and 0.52% – 0.67% by Panigrahi *et al*. [15]. The dry matter content of the diet was between 91.74% to 93.78% and comparable to the 90.64% to 91.48% reported by Ladokun *et al*. [16], and 90.95% to 92.12% by Panigrahi *et al*. [15]. The crude protein content of 24.99% to 25.05% corresponds to the level recommended for growing quail [3] though understandably higher than the 22.3% to 22.8% for starter broilers [14]. The differences in the values reported in the present study did not vary significantly between the diets and therefore, should not exert a divergent effect on the performance of the birds. These differences may be due to different diets formulated and types of feed materials used.

The Japanese quail in this study started laying eggs by 32nd day of age, which is approximately five weeks of life which is in consonance with the earlier reports [3]. This also indicates the level of management and the quality of the diets involved. Martins [17] had reported that egg production among Japanese quails starts between the 5th and the 6th week of life even though adult plumage is not attained until the 12th week.

Feed intake values were similar for birds fed diets A (14.21g/bird/day), B (14.17g/bird/day) and C (14.05g/bird/day). However, feed intake values for D and E were significantly higher than values for C only. This result is quite similar to the report of Maphosa *et al*. [14] of similar feed intake of broilers from the control up to the diet with 50% of maize replaced with sweet potato meal, but that on the 75% replacement of maize, intake was significantly higher than on the previous diets. Agwunobi [5], however, reported no adverse effect on feed intake when sweet potato meal was fed at 27% and 30% inclusion levels, respectively, in broiler starter and finisher diets. Similar results were obtained when maize was substituted with sweet potato meal at 24% for broilers [19]. On the other hand, the two reports, Agwunobi [5] and Lee [19], may not be different from the observations in this study when the levels of sweet potato meal used are considered.

Mean daily water intake was significantly highest in birds fed diet D (27.40ml/bird/day) while those on the rest of the test diets (i.e. B, C, and E) were similar. The birds on the control diet recorded the lowest value (23.77ml/bird/day). However, no significant differences exist between water intake on diets D and E (26.21ml/bird/day). The daily water consumption recorded in this study is close to the 33.07ml/bird as reported by Rajput [20] for growing quail but much lower than the range of 38.93-44.28ml/bird as

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reported in Tuleun *et al*. [21] for growing quail. This higher range reported by Tuleun *et al*. [21] may be due to the higher ambient temperature in Makurdi, Nigeria (25-37^{o}C) where the authors carried out their study. Ezieshi *et al*. [22] had also reported increased water intake for birds in warmer environments compared to colder ones obviously to regulate body temperature. The increase in water intake may be as a result of the "sweet" in sweet potato especially at the 75 and 100% replacement of maize with sweet potato tuber meal which has a tendency to make birds drink more water. According to reports, roasting, a common traditional method of preparing sweet potato tubers for human consumption, imparts sweetness to the feedstuff by activating the amylases present such that some starch is hydrolyzed to sugars [15]. This is probably what happened since the sweet potato was cooked. It is, however, interesting that at the complete (100%) replacement of maize with sweet potato tuber meal, there were no significant differences when compared to diets A, B, and C and this may be due to some adjustments made by the quail birds that kept the feces hard and not watery. Watery faeces had been reported for broilers on sweet potato meals above 30% of the diet [5].

Mean daily weight gain of quail chicks was not affected by the diets. This is in agreement with an earlier report [18] even at 80% level of replacement of maize with sweet potato meal for broilers. This is, however, contrary to the report of Maphosa *et al*. [14] and Afolayan *et al*. [23] who reported on broilers, and Gonzalez [24] working with pigs. The non-significant effect of sweet potato tuber meals on weight gain in this work agrees with the report of Dominguez [25] who worked on pigs, and Garba *et al*. [26] who found no significant effect of sweet potato meal on performance of broilers, and adduced that the inactivation of trypsin inhibitors by cooking was responsible. The decline in weight gain with increasing content of sweet potato meal may be due to the different species used in the trial [14, 23].

Feed conversion ratio of quail birds fed the various diets were not significantly different. However, there was a slight decrease in the efficiency of feed conversion as compared to the control, as birds on the sweet potato diets performed numerically worse. This had been attested to in Muhammad *et al*. [18] in the overall performance of broilers. The reports of Maphosa *et al*. [14] and Afolayan *et al*. [23], however, disagree with this finding. According to Afolayan *et al.* [23] broiler chicks on the sweet potato meal diets were significantly better feed converters. This was not observed in the study with growing Japanese quail in this work.

The cost of feed per unit of gain (₦240/kg or 1.46USD) was interestingly similar for each of the diet even though the cost of feed per kilogram decreased as the level of sweet potato in the feed increased. This is in disagreement with the observations by some other authors [23] for broilers and [27] for quail chicks. The feed cost per gain did not increase because the sweet potato tuber meal used in this study was cheaper than maize. Also, feed cost per kilogram of feed reduced from the control (N68.98/kg) to the complete (100%) replacement with sweet potato tuber meal (N66.91/kg). The disparity between this report and that of previous authors may be as a result of different market prices for various feedstuffs used in the studies reported. The similarity between the diets in terms of feed cost per gain is in agreement with other reports where cooked sweet potato was employed for broilers [18].

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Protein intake on daily basis decreased inconsistently from 3.55g/bird (diet A) to 3.51g/bird (diet C) and increased again to 3.72g/bird (diet D). Values for the remaining diets were lower than for diet D. There was a significant difference between protein intake on diet D and intakes on diets A, B, and C. Other differences were not significant. The higher protein intake on diet D may be due to higher feed intake by birds on that diet. The range of protein intake of 1.80 -1.96g reported by Tuleun *et al*. [21] for growing Japanese quail is lower than the 3.51 -3.72g/bird reported in the present study and may be due to differences in diets used and the higher environmental temperature in Makurdi (25 – 37^{o} C) where Tuleun's study was conducted, since birds consume less feed at higher temperatures as compared to lower temperatures [22].

The daily metabolizable energy intake in this study ranged from 37.23 to 35.61kcal/g/bird which is lower than what was reported for Japanese quail reared in Britain by Farrell *et al*. [28]. They reported that the daily metabolizable energy intake for quail was 57, 48 and 52 kcal/kg body weight at 12, 19 and 26 days of age, which is much higher than that reported in this present work probably because of the differences in the climate where the works were carried out. British ambient temperatures range between 6 – 18^{o}C against 13.9 – 28.6^{o} C for the location of the present study. Therefore, increased consumption of energy to satisfy body requirement became mandatory for birds reared under such conditions.

Apparent dry matter digestibility was significantly higher on the control diet (78.38%) than on sweet potato diets. A similar result was documented by Gerpacio *et al*. [6] for broilers on sweet potato diets and by Dominguez [25] for pigs. The values reported by previous researchers Dominguez [25] and Gerpacio *et al*. [6] were 94.50% and 85.50%, and 72.00% and 70.1%, respectively, for the control and the sweet potato diets. The highest value obtained from birds on the test diets in the present study was from birds on diet C (72.16%). While this figure seems close to that reported by Gerpacio *et al*. [6], it was much lower than the value reported by Dominguez [25] and 81.05% – 88.73% reported by Malik *et al*. [29] for growing rabbits on sweet potato peel meal and this may be due to differences in animal species employed in the various studies.

Apparent digestibility of crude protein was significantly higher for birds on diet C (57.73%) than for those on diets A (50.29%), B (53.84%) and E (51.45%) but was similar to the digestibility of crude protein on diet D (54.53%). The range of protein digestibility in the present work was between 50.29 – 57.73 % which is lower than 61.80 – 72.60% for broilers reported by Gerpacio *et al*. [6] but close to the protein digestibility for cooked sweet potato meal (52.80%) for pigs as reported by Canope *et al*. [10].

Ether extract digestibility varied between 81.22% (diet E) and 61.86 % (diet B) with figures for other diets lower than for diet E. However, the differences were significant. Ether extract digestibility on diet E was significantly higher than for the other diets. This is contrary to the report of rabbits fed sweet potato peel meal [29]. The digestibility of ether extracts (79.18 – 89.90 %) as reported in Malik *et al*. [29] is much higher than the report of the present study and may be responsible to differences in species and diets employed in their study. Whereas the crude protein digestibility in the report of Malik

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et al. [29] was not significant across the diets, in the present report, crude protein digestibility was significantly superior on the diet with 50% peeled cooked sundried sweet potato tuber meal compared to the other diets apart from diet D. This seems to confirm the report that cooking increased the digestibility of nutrients [10].

CONCLUSION

Sweet potato is well suited to Nigeria's climate and does well particularly in the savannah regions, and has been known to be cheaper to produce than cereals. Parameters measured to determine the effect of feeding peeled cooked sundried sweet potato tubers at 0, 25, 50, 75 and 100% replacement of maize in the diet for quail chicks showed that feed intake was significantly higher on the 75 and 100% replacement of maize with sweet potato than on the control and 25% level of replacement. Water intake was higher on the sweet potato diets than on the control. Protein intake was significantly higher on the sweet potato diets than on the control. Energy efficiency ratio was significantly better on the diet with complete replacement of maize than on the control. Furthermore, digestibility of crude protein and ether extract was significantly better on the sweet potato diets than on the control. Therefore, for growing Japanese quail diet, maize could completely be replaced by peeled, cooked, sundried sweet potato tubers without adverse effect on performance.

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Table 1: Composition of growing quail experimental diets containing peeled, cooked, sundried sweet potato meal (%)

	Diets					
Ingredients	A	B	C	D	E	
Maize	31.20	22.71	14.19	5.67	0	
Sweet potato meal	0	7.80	15.60	23.40	31.20	
Ground nut cake	38.10	38.79	39.51	40.22	38.10	
Wheat offal	10.00	10.00	10.00	10.00	10.00	
Fish meal	1.50	1.50	1.50	1.50	1.50	
Palm kernel cake	15.00	15.00	15.00	15.00	15.00	
Bone meal	2.00	2.00	2.00	2.00	2.00	
Limestone	1.50	1.50	1.50	1.50	1.50	
*Vitamin Premix	0.25	0.25	0.25	0.25	0.25	
Salt	0.25	0.25	0.25	0.25	0.25	
Lysine	0.10	0.10	0.10	0.10	0.10	
Methionine	0.10	0.10	0.10	0.10	0.10	
Feed cost/diet (₦)	68.98	68.41	67.84	67.28	66.91	
	100	100	100	100	100	
Dry matter	91.54	91.93	91.42	92.07	91.77	±1.20NS
Crude protein	25.06	25.06	25.11	25.05	25.10	±0.08NS
Ash	7.55	7.23	8.58	10.81	9.97	±2.69NS
Ether extract	6.76	7.15	8.54	6.65	10.35	±2.74NS
Crude fibre	3.91	5.22	4.47	5.33	6.75	±1.51NS
Nitrogen free extract	48.26	47.27	44.72	44.23	39.60	±4.10NS

* Hi Nutrient premix supplied the following per 100kg of diet: Vitamin A, 1,200,000 I.U; Vitamin D_3 250,000 I.U; Vitamin E, 3,000 I.U; Vitamin K, 200mg; Thiamin (B_1), 225mg; Riboflavin (B_2), 600mg; Pyridoxine (B_6), 450mg; Niacin, 4000mg; Vitamin B_{12}, 2mg; Pantothenic acid, 1,500mg; Folic acid, 150mg; Biotin, 8mg; Choline chloride, 30,000mg; Anti-oxidant, 12,500mg; Manganese, 8,000mg; Zinc, 5,000mg; Iron, 2,000mg; Copper, 500mg; Iodine, 100mg; Selenium, 20mg; Cobalt, 50mg. Key: C.P, crude protein; M.E, metabolizable energy; Ca, calcium; P, phosphorus; C.F, crude fibre

Key: A = Control (no cooked sundried sweet potato meal), B = Diet with 7.80% of maize replaced by peeled cooked sundried sweet potato meal, C = Diet with 15.60% of maize replaced by peeled cooked sundried sweet potato meal, D = Diet with 23.40% of maize replaced by peeled cooked sundried sweet potato meal, E = Diet with 31.20% of maize replaced by peeled cooked sundried sweet potato meal. SEM - Standard error of mean., N.S – not significant (P >0.05). Why subject the nutrient content of the experimental diets to statistical analysis?

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Table 2: Effects of different inclusion levels of peeled and cooked sundried sweet potato tuber meal diets on performance of growing Japanese quail birds

	Diets					
Parameters	A	B	C	D	E	SEM
Initial wt (g/bird)	7.00	7.00	6.80	6.98	7.03	±0.14NS
Final wt (g/bird)	143.33	141.67	142.58	148.83	147.17	±3.25NS
Feed intake(g/b/d)	14.21^{ab}	14.17^{ab}	14.05^{b}	14.87^{a}	14.79^{a}	±0.34*
Water intake(ml/b/d)	23.77^{b}	24.01^{b}	24.66^{b}	27.40^{a}	26.21^{ab}	±1.24*
Weight gain(g/b/d)	3.89	3.85	3.88	4.06	4.00	±0.09NS
FCR	3.29	3.60	3.46	3.54	3.61	±0.21NS
Energy intake (kcal/g)	37.23	36.57	35.61	37.02	36.38	±0.84NS
Protein intake(g)	3.55^{a}	3.54^{a}	3.51^{a}	3.72^{b}	3.69^{ab}	±0.04*

Key: a, b, means bearing letters with same superscripts within the same row are not significantly (p > 0.05) different. SEM= standard error of mean. N.S = not significant, A= control (no sweet potato tuber meal); B= diet with 7.80% peeled cooked sweet potato tuber meal; C= diet with 15.60% peeled cooked sweet potato tuber meal; D= diet with 23.40% peeled cooked sweet potato tuber meal; E= diet with 31.20% peeled cooked sweet potato tuber meal.; FCR, Feed conversion ratio

Table 3: Apparent digestibility of nutrients in diets containing peeled cooked sundried sweet Potato tuber meal fed to growing Japanese quails (%)

	Diets					
Parameters	A	B	C	D	E	SEM
Dry matter	78.38a	71.53^{b}	72.16^{b}	70.33^{b}	70.80^{b}	±2.93*
Crude protein	50.29^{b}	53.84^{b}	57.73^{a}	54.53^{ab}	51.45^{b}	±1.67*
Ether extract	67.31^{b}	61.86^{b}	67.61^{b}	65.61^{b}	81.22^{a}	±3.70*

Key: a, b, means bearing letters with same superscripts within the same rows are not significantly (P > 0.05) different. SEM = standard error of mean. A= Control (no sweet potato tuber meal), B = Diet with 7.80% peeled cooked sundried sweet potato tuber meal, C= Diet with 15.60% peeled cooked sundried sweet potato tuber meal, D= Diet with 23.40% peeled cooked sundried sweet potato tuber meal, E =Diet with 31.20% peeled cooked sundried sweet potato tuber meal

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