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Growth Performance and Carcass Evaluation of Quails Fed Graded Levels of Water Soaked Sweet Orange Peel Meal (SOPM)

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Abstract
An experiment was carried out at Plateau State College of Agriculture Garkawa Poultry unit to investigate the effect of inclusion levels on performance and carcass characteristics of Japanese quails feds water soaked sweet orange peel meal (SOPM). Two hundred and sixteen (216) two weeks old Japanese quails were randomly allocated to six dietary treatments of thirty six quails each in three replicates of twelve quails in a completely randomized design. Inclusion levels of water soaked SOPM were 0, 5, 10, 15, 20 and 25% and were used to replace maize. Body weights were taken weekly. The results showed that water soaking significantly ($p<0.05$) reduced the mean final body weight gain for 10 -25% inclusion levels and feed conversion ratio for the same treatments were higher than the control diet and 5% inclusion level. There were no significant differences for initial live weight and feed intake. Carcass result differed ($P<0.05$) significantly for final live weight, bled weight and kidney for internal organs among treatments while other parts did not differ ($p>0.05$) significantly. It was concluded that 5% water soaked SOPM can be recommended in Japanese quail diets.
Key Words: Sweet orange peel meal, Water soaking, Growth performance, Carcass characteristics, Japanese quail

Introduction

One of the fastest ways of bridging gap between demand and supply of animal protein in the developing countries, Nigeria inclusive, is the production of animals with short generation intervals like quails. Because of the high cost of conventional feedstuff like maize, Guinea corn, and Millet, in developing countries such as Nigeria, animal nutritionists advocated the use of nonconventional feed ingredients for farm animal feed production. One of such feed ingredients is the sweet orange peel meal, a by-product of sweet orange (*Citrus senensis*) fruits which is not in competition with man's dietary needs.

Maize accounts for about 45 to 55 % of poultry feed (Bamgbose *et al*., 2004), therefore, any effort to substitute maize in poultry feed will significantly reduce the cost of production. Olubamiwa, *et al*. (1999) had also successfully replaced 14 % maize with cocoa husk meal (CHM) with no depressive effect on the growth of quail chicks. Florou-Paneri *et al.* (2001) reported that using up to 6% dried citrus pulp in laying quail diets had no significant adverse effect on performance. Dried citrus pulp with addition of a probiotic (*Saccharomyces cerevisiae*) could replace up to 10% of maize grain in Nile tilapia fingerling diets without any adverse effects on growth parameters, nutrient digestibility or immune status (El-Sayed *et al.*, 2010). A summary of earlier experiments reported 7.5% value as the most reasonable (El Boushy *et al.*, 2000). Oluremi *et al*. (2006) and Agu *et al*. (2010) reported that sun-dried sweet orange rinds collected from peeled orange retailers could be used to replace up to 15-20% maize (about 7-9% of the total diet) in the diet of broilers without any adverse effect on performances. Adesiji *et al*. (2012) reported that different levels of Tallow seed meal inclusion had no significant ($P>0.05$) effect on the live body weight, carcass weight, dressing percentage and internal organs (liver, heart, gizzard and lungs) of Japanese quails as well as the degree of nutrient utilization. Significant ($P<0.05$) differences were observed across the dietary treatments for dressing weight.

Citrus sinensis (Ibadan variety) had the following nutrient composition 89.57% dry matter, 10.49% crude protein, 14.81% crude fiber, 2.54% ether extract, 5.54% ash, 65.30% nitrogen free extract and 2990 (Kcal/kg) gross energy; and (Washington variety) also contains 89.71% dry matter, 10.96% crude protein, 13.66% crude fiber, 2.35% ether extract, 5.56% ash, 67.57% nitrogen free extract and 2980 (Kcal/kg) gross energy (Oluremi *et al., 2007).* In a separate work, Oluremi *et al.* (2008) reported crude protein value of 7.44%, crude fiber 12.9%, ether extract 2.29%, ash 3.85%, nitrogen free extract 73.5%, and dry matter of 85.9% for sweet orange peel not fermented. Agu *et al.* (2010), on the other hand, reported a crude protein value of 10.73%, crude fiber of 7.86%, ether extract of 12.60%, ash content of 11.90%, nitrogen free extract of 56.91% dry matter of 89.65% and metabolizable energy of 3988.70 Kcal/kg.

Lee *et al.* (1981) and Haruna, *et al*. (1997) had recommended crude protein levels of 24 % and 22 to 25 % respectively for quail chicks and Olubamiwa, *et al*. (1999) also recommended metabolizable energy levels of between 2,500 and 2,800-kcal/kg diet for growing quails. The Japanese quail is an important laboratory and productive bird because of its small body size, and attainment of sexual maturity at 6 to 7 weeks of age, high

prolificacy, ability to produce 3 to 4 generations in a year and relative ease of maintaining the colony (Shim and Vohra, 1984). Among other birds, the meat and eggs of quails have less fat and low cholesterol content which is of public health importance and has been suggested as good quality meat source for diabetic patients and those with high blood pressure (Agwunobi and Ina-Ibor, 2007). To avert the problem of low animal protein deficiency, the production of animals with short generation interval such as quail is needed.

This study was designed to evaluate the growth performance and carcass characteristics of Japanese quails (*Coturnix coturnix japonica*) fed graded levels of water soaked sweet orange peel meal.

Material and Methods

The research work was carried out at the poultry unit of Plateau College of Agriculture, Garkawa. The experiments were conducted between November, 2012 and January, 2013. Two hundred and sixteen (216), two-week old Japanese quails were bought from the National Veterinary Research Institute (NVRI), Vom, Plateau State, Nigeria. The birds were randomly allocated to six dietary treatments of thirty six quails each in three replicates of twelve quails. The quails were weighed in groups and the average weight determined before being assigned to their respective treatment groups. The birds were allowed access to feed and water *ad libitum*. Kerosene stoves were used for the first one week to supply the required heat. The birds were reared on deep litter system. Routine management operations included daily cleaning of drinkers, feeders and supply of fresh feeds and water. Six experimental diets were formulated to contain percentage inclusion levels of 48-hour water soaked sweet orange peel meal (0, 5, 10, 15, 20 and 25) at the expense of maize. The diets represented by $SOPM_0$, $SOPM_5$, $SOPM_{10}$, $SOPM_{15}$, $SOPM_{20}$ and $SOPM_{25}$ respectively containing 23.96% -24.39% crude protein with 2826.91 Kcal/kg as presented in Table 1. Body weight and feed intake of quails were recorded weekly and the experiment lasted 35 days. From the mean body weights and feed intake, feed conversion ratio was calculated. Body weight gain was obtained by subtracting initial body weight from final weight of the birds. Carcass evaluation was carried out at the last day of the experiment. The birds were slaughtered at 36 days of age. Six birds from each treatment (two per replicate) were selected, starved overnight (16 hours) but with access to drinking water, the birds were weighed to obtain the live weight, bled and weighed again to obtain the bled weight. Through careful dissection after scalding, each body part or organ was removed and weighed on an electronic scale. Dressed weights were also taken.

Data obtained was subjected to analysis of variance (ANOVA) using the SPSS (2007) statistical software model for the completely randomized design. Where significant differences were observed, means were separated using Duncan's Multiple Range Test (DMRT) as outlined by Duncan (1955).

RESULTS AND DISCUSSION

The productive performance of Japanese quails fed diets containing water soaked sweet orange peel meal is presented in Table 2. The results show that mean body weight, weight gain and feed conversion ratio were significantly ($p<0.05$) affected as inclusion level of water soaked SOPM increased. The final live weight is in agreement with the reports of Adesiji *et al*. (2012). However, 5% SOPM (133.65g) recorded a higher body weights than 96.43 – 128.89g reported by Adesiji *et al*. (2012). Mean final body weight gain of quails fed from 10% to 25% were significantly ($p<0.05$) lower than those fed the control and 5% diets. No significant ($P>0.05$) differences were observed for feed intake of quail fed the experimental diets. The results of the present study showed that feed intake of Japanese quail was not significantly affected by the inclusion levels of water soaked SOPM. This result is in contrast of what was reported by Edache *et al*. (2005), when they fed graded levels of yam peels to quail. They reported significant ($p<0.05$) differences in feed intake in quails fed diets containing yam peel meal compared to the control. However, the aforementioned results agree with those of Adesiji *et al*. (2012) who reported no significant difference for Japanese quails fed graded levels of *Detarium microcarpum* seed meal based diets.

The lowest feed conversion ratio of the control showed that this diet was better than SOPM based diets. Among SOPM based diets, diets 2-5 (5 - 20%) had similar values of feed conversion ratio which were significantly better than diet 6. This was due to the fact that increase in inclusion level of water soaked SOPM increased the fiber level of the diet as reflected in Table 1. Therefore, Japanese quails could not utilize above 5 % SOPM as earlier reported by Florou-Paneri *et al.*(2001) that using up to 6% dried citrus pulp in laying quails diets had no significant adverse effect on performance. Increase in the inclusion level of water soaked SOPM had effects on the utilization of the diets by reducing absorption of nutrients.

The result of carcass characteristics is presented in Table 3. Plucked and dressed weight, dressing percentage, and carcass cuts, percent live weight, such as drumstick, thigh, neck, breast, back, wings, head and shank were not significantly different across the dietary treatments. The values obtained for dressing percentage in this study

(49.73 – 54.96%) were lower than (65.43 – 70.43%) reported by Adesiji et al. (2012). The developments of these organs by birds fed with SOPM based diets were not inferior to the control maize-based diet. However, the final live and bled weight showed a significant treatment effect. The effect of substituting water soaked SOPM with maize resulted in significant decrease in final live and bled weight of quails as its inclusion levels increased from 5 to 25%.

The results in Table 4 indicated no significant ($p>0.05$) effect for internal organs like proventriculus, heart, lungs, liver, pancreas, gizzard, visceral and abdominal fat, intestinal weight and empty crop. Also caeca, small and large intestine length followed the same patterns. This demonstrated that the diets were digested and also implies that it could be used as a substitute for maize in quail diets. But kidneys showed a significant ($p<0.05$) treatment effect across treatments. The changes in kidney weight were, however, irregular.

Conclusion

There was no observable negative effect on the health status of quails fed the dietary treatments. This may suggest that Japanese quails are tolerant to common poultry disease since no medication was used throughout the period of the study. The gizzard an organs involved in digestion and plucked weight was not significantly ($p>0.05$) influenced. This suggests that digestion and feather development processes were not affected by inclusion of SOPM in the diets. Also, normal blood circulation was not affected because there were no significant ($p>0.05$) differences among treatments for the heart. Since 5% water soaked SOPM is comparable with the control diet, it can adequately replace maize in quail nutrition at this level without any negative effect on growth performance and carcass characteristics.

Recommendation

The performance evaluation recommended 5% SOPM inclusion into the diet of quail without adverse effect since the performance response of the birds at 5% inclusion level were statistically similar with the control diet. However, if fast gain is not a focus 10 – 15% inclusion may be considered since adult unsexed quails fed with the diets had an average weight that fell within the recommended average weight of 100 – 140g (adult male) and 120 – 160g (adult female) as reported by Randall and Bolla (2008).

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Appendix

Table 1: Percentage inclusion level of water soaked sweet orange peel fed Japanese quail.

Ingredients	Inclusion levels of water soaked SOPM					
	T_1 (0%) SOPM	T_2 (5%) SOPM	T_3 (10%) SOPM	T_4 (15%) SOPM	T_5 (20%) SOPM	T_6 (25%) SOPM
Maize	47.02	44.67	42.32	39.97	37.62	35.26
SPOM	0.00	2.35	4.70	7.05	9.43	11.76
SBM	37.72	37.72	37.72	37.72	37.72	37.72
Blood meal	3.00	3.00	3.00	3.00	3.00	3.00
Maize offal	7.75	7.75	7.75	7.75	7.75	7.75
Bone meal	2.95	2.95	2.95	2.95	2.95	2.95
Oystershell	0.50	0.50	0.50	0.50	0.50	0.50
Methionine	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25
Premix*	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.31	0.31	0.31	0.31	0.31	0.31
Calculated nutrients						
ME (Kcal/kg)	2826.91	2826.91	2826.91	2826.91	2826.91	2826.91
Crude protein (%)	23.96	24.08	24.15	24.23	24.31	24.39
Crude fiber (%)	4.38	4.87	5.39	5.90	6.41	6.91
Ether extract (%)	2.33	2.31	2.28	2.26	2.24	2.22
Calcium (%)	1.20	1.22	1.25	1.27	1.29	1.32
Phosphorus (%)	0.70	0.70	0.70	0.70	0.70	0.70

*Vitamin-Mineral premix (BIOMIX(R)) will supply per kg diet, Vit. A 500IU; Vit. D_3 888, IU; Vit. E_{12}, 000mg; Vit. $K_3$15000mg; Niacin 12000mg; Pantothenic acid 2000mg, Biotin 1000mg; Vit b12 3000mg; Folic acid 15000mg; Choline chloride 6000mg, Manganese 1000mg; Vit. Iron 15000mg; Zinc 800mg; Copper 400mg; Iodine 80mg; Cobalt 400mg; Selenium 8000mg. T1 = Diet did not contain water soaked SOPM, T2 = Diet contained 5% water soaked SOPM, T3 = Diet contained 10% water soaked SOPM, T4 = Diet contained 15% water soaked SOPM, T5 = Diet contained 20% water soaked SOPM, T6 = Diet contained 255% water soaked SOPM, % = percentage and SOPM = sweet orange peel meal

Table 2: Growth performance of Quail fed graded level of water soaked SOPM

Parameters	Inclusion levels of water soaked SOPM							
	T1	T2	T3	T4	T5	T6	Total mean	SEM
Mean initial body weight (g/bird)	21.91	23.81	25.24	26.67	25.48	22.46	24.26	0.69^{ns}
Mean final body weight (g/bird)	149.24^{a}	133.65^{ab}	121.99^{bc}	121.82^{bc}	109.68^{c}	103.81^{c}	123.26	4.23*
Mean feed intake (g/bird)	561.05	568.17	611.80	554.17	525.23	520.80	556.87	11.34^{ns}
Mean body weight gain (g/bird)	127.27^{a}	109.84^{ab}	96.75^{bc}	95.62^{bc}	84.20^{c}	81.35^{c}	97.98	4.33*
Feed conversion ratio	4.45^{c}	5.20^{bc}	6.31^{ab}	5.89^{ab}	6.24^{ab}	6.49^{a}	5.83	0.21*

Means having the same letter(s) in a column are not significantly (p>0.05) different, Ns = Not significant, SEM = Standard error of mean, T1 = Diet did not contain water soaked SOPM, T2 = Diet contained 5% water soaked SOPM, T3 = Diet contained 10% water soaked SOPM, T4 = Diet contained 15% water soaked SOPM, T5 = Diet contained 20% water soaked SOPM, T6 = Diet contained 255% water soaked SOPM, % = percentage and SOPM = sweet orange peel meal

Table 3: Carcass characteristics of Quail fed diet contain graded levels of water soaked SOPM.

Parameters	Inclusion levels of water soaked SOPM							
	T1	T2	T3	T4	T5	T6	Total mean	SEM
Final live weight (g/bird)	153.43^{a}	135.67^{b}	134.33^{b}	134.20^{b}	133.33^{b}	123.67^{b}	135.77	2.84*
Bled weight (g/bird)	145.83^{a}	129.90^{b}	129.80^{b}	127.47^{b}	128.67^{b}	119.00^{b}	130.11	2.56*
Plucked weight (g/bird)	135.93	124.20	124.87	120.63	130.27	107.67	123.93	3.34ns
Dressed weight (g/bird)	76.17	67.57	67.17	69.73	72.86	63.63	69.52	1.67ns
Dressing %	49.73	49.77	49.98	51.97	54.96	52.08	51.42	1.35ns
Carcass cuts (% L.W)								
Drumstick	5.69	5.56	5.44	5.84	6.57	5.79	5.81	0.14ns
Thigh	8.99	8.96	8.50	8.89	9.79	9.74	9.15	0.26ns
Neck	4.42	4.46	5.25	4.97	4.73	5.42	4.87	0.20ns
Breast	23.53	22.33	24.33	23.87	25.90	24.50	24.08	0.65ns
Back	11.50	13.03	11.54	13.50	12.77	9.81	12.02	0.85ns
Wings	5.66	6.33	5.47	6.06	6.00	5.98	5.92	0.16ns
Head	3.80	4.00	3.85	4.26	4.39	4.00	4.05	0.10ns
Shank	1.61	1.61	1.80	1.53	1.88	1.79	1.70	0.07ns

Means having the same letter(s) in a column are not significantly (p<0.05) different
Ns = Not significant, SEM = Standard error of mea, T1 = Diet did not contain water soaked SOPM, T2 = Diet contained 5% water soaked SOPM, T3 = Diet contained 10% water soaked SOPM, T4 = Diet contained 15% water soaked SOPM, T5 = Diet contained 20% water soaked SOPM, T6 = Diet contained 255% water soaked SOPM, % = percentage and SOPM = sweet orange peel meal

Table 4: Internal Organs characteristics of Quai fed diets containing graded level of water soaked SOPM

	Inclusion levels of water soaked SOPM							
Parameters	T1	T2	T3	T4	T5	T6	Total mean	SEM
Proventriculus (% L.W)	o.41	0.44	0.54	0.42	0.55	0.50	0.48	0.03ns
Kidney (% L.W)	0.30bc	0.94a	0.56b	0.37bc	0.16c	0.30bc	0.44	0.07*
Heart (% L.W)	0.95	0.93	0.94	0.89	0.98	0.92	0.93	0.03ns
Lungs (% L.W)	0.80	0.78	1.01	0.75	1.03	0.75	0.85	0.06ns
Liver (% L.W)	2.30	2.77	3.52	2.37	3.15	2.35	2.74	0.24ns
Pancreas (% L.W)	0.23	0.24	0.32	0.17	0.22	0.30	0.25	0.21ns
Gizzard (% L.W)	2.28	2.84	3.14	2.48	3.24	2.85	2.80	0.21ns
Visceral fat (% L.W)	0.83	0.87	0.95	0.58	0.52	1.09	0.81	0.11ns
Abdominal fat (% L.W)	0.66	0.83	0.70	0.42	0.48	1.09	0.70	0.58ns
Intestine weight (% L.W)	2.98	4.40	2.89	3.16	5.08	4.63	3.86	0.37ns
Empty crop (% L.W)	0.27	0.54	0.56	0.76	0.71	0.86	0.62	0.08ns
Caeca length (cm)	14.37	12.43	13.50	12.53	14.56	15.37	13.79	0.86ns
S. I. Length (cm)	50.67	52.60	41.90	49.97	54.40	50.60	50.02	1.61ns
L.I. Length (cm)	5.97	7.77	5.63	4.50	7.77	6.73	6.39	0.44ns

Means having the same letter(s) in a column are not significantly ($p<0.05$) different
Ns = Not significant, SEM = Standard error of mea, T1 = Diet did not contain water soaked SOPM, T2 = Diet contained 5% water soaked SOPM, T3 = Diet contained 10% water soaked SOPM, T4 = Diet contained 15% water soaked SOPM, T5 = Diet contained 20% water soaked SOPM, T6 = Diet contained 255% water soaked SOPM, % = percentage and SOPM = sweet orange peel meal

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