PERFORMANCE OF BROILER CHICKEN FED SUN-DRIED PINEAPPLE (*Ananas comosus*) AND ORANGE (*Citrus sinensis*) PEELS WASTE BASED DIETS UNDER SINGLE PHASE FEEDING

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Abstract:

This study was conducted to determine the effect of orange(OP) and pineapple(PP) peel wastes as replacement for maize in poultry diets. The peels were collected from retailers and sun-dried until a 10 % moisture was obtained. Thereafter, the peels were grounded and mixed with other feed ingredients. The experiment lasted for 70days. One hundred and sixty (160) days old broiler chicks were allocated into four different treatments with four replicates and ten birds (10) each in a complete randomized design. Four diets containing pineapple and orange peels wastes were formulated to replace maize at 0 % (control), 5 % (PP), 5 % (OP) and 5 % (MPO) mixtures respectively. Data on growth performance such as weight gain, feed intake and feed conversion ratio were measured and apparent nutrient digestibility was also determined. Data were subjected to one-way Analysis of Variance (ANOVA); significant means were separated by Duncan's Multiple Range Test at (p<0.05) as contained in the SAS package (2015) version 15.0. The results showed that only the feed conversion ratio (FCR) was influenced by the peels based diets. The dry matter, crude protein, ash, nitrogen free extract and ether extract digestibility were significantly affected (p < 0.05) by the peel-based diets. Birds on the MPO compared favourably with the control in all digestibility parameters measured. It was concluded that broiler birds could tolerate up to 5 % dietary levels of OP, PP meal and their mixture (MPO). without adverse effect.

Keywords – Pineapple peel, orange peel, performance, poultry, digestibility.

INTRODUCTION

In the recent years, crop residue and agro-industrial by products are being evaluated to access their nutritive potential to support poultry productivity (Oluremi *et al*., 2007). A number of agro-industrial by-products are generated from fresh citrus and pineapple after the main products of interest have been removed or extracted during processing or peeled for direct human consumption as it occurs in the developing countries (Oluremi *et al*., 2007). Citrus and pineapple waste disposal is a problem for agro-industrial manufacturing companies. Some of the wastes from fruits processing may be good sources of essential nutrients and, therefore, could be utilized as part of the feed ingredients. If these wastes are properly processed and incorporated in poultry animal rations, these agro-wastes can serve useful purposes by imparting nutrients as well as flavour to the ration and hence increase its palatability and utilization, besides lowering the cost of feed. In Nigeria, all the varieties of orange and pineapple are consumed on a high scale, and the peels are usually considered as wastes and are seen littering the streets and roadsides. As such, orange and pineapple peels have become an environmental problem. It is on this note that Ipinloju (2000) suggested that rather than discarding these peels, they can be sun-dried and then milled to obtain fine-particles of orange and pineapple peel meals which can be included in poultry diets. Some studies were conducted to develop a procedure for converting pineapple waste into animal feed (Sruamsiri, *et al*., 2007; Makinde, *et al*., 2011). Problems related to the fresh form were overcome by the sun drying technique of pineapple peels developed by Aboh, *et al*. (2004) which gave dried peels of good quality.

Objective of the study. To investigate the performance of broiler birds fed sun-dried orange(OP) and pineapple(PP) peels wastes based diets.

METHODOLOGY

The research was carried out at the Poultry Unit of Department of Animal Production Teaching and Research Farm of School of Agriculture and Agricultural Technology, Gidan kwano campus Minna, Niger state. Niger state is located on latitude 10˚00 N and longitude 6˚01 E. Niger State experiences distinct dry and wet seasons with annual rainfall of 1400 mm. The rainy seasons last for about 120 150 days. The temperature is between 30˚C minimum and 34˚C maximum; the humidity is about 53.5

% while the altitude is about 299 m above sea level. Presently, the state covers a total land area of 76,363.0 km ^{2} (Afolayan *et al.*, 2012).

Diet preparation

Pineapple and orange peels were collected from retailers sell points in Minna metropolis, where the retailers peel the fruit for consumers and discard the peels. The peels were sun-dried to attain 10% moisture and milled to obtained pineapple and orange peels meals which were used to replace maize at 0 % (Control) 5 % pineapple peel (PP), 5 % orange peel (OP) and 5 % each of pineapple and orange peels (MPO). The other feed ingredients: soya bean, fishmeal, bone meal, limestone, maize offals, groundnut cake were purchased from Sammy Agro Venture, Nigeria limited, located at U.K Bello way Minna, Niger State. Maize, palm oil and salt were purchased from Central Market Minna, Niger State. The composition of the experimental diets and the nutritive value of the test materials is presented in Table1.and Table 2 respectively.

The Experimental Birds, Design and Managements

One hundred and sixty (160) day old (Ross 308) broiler chicks were purchased from a reputable hatchery (Agrited) in Ibadan which were used for the experiment. The experimental birds were randomly allocated into four dietary treatments namely, T1 (control), T2 (5 % pineapple peels meal), T3 (5 % orange peels meal), and T4 (2.5 % each of orange and pineapple peels meals) at the rate of 40 birds per treatment. Each dietary treatment was replicated four times and had 10 birds per replicate using a completely randomized design. The birds were raised on a deep litter system. Before the commencement of the feeding trial, the Poultry Unit was washed thoroughly with disinfectant (Vinkokill 150ml/25 litres of water) and allowed to dry to prevent the spread of diseases from the previous research. The experimental birds were subjected to brooding with kerosene lamp and charcoal as sources of illumination and heat respectively. Treatment diets and water were administered *ad-libitum*. Routine management practice such as vaccination, drug administration and cleaning of the pens and equipment were carefully applied.

Data Collection

Initial weights were determined at the start of the experiment with the aid of salter weighing scale (SGF 400) balance and thereafter at weekly intervals. The final weight was also taken by weighing the birds in each replicate on the last day of the experiment using the same weighing balance. The weight gain was calculated by subtracting the initial weight from the final weight. In addition, the feed intake was calculated by subtracting the feed remaining from the total feed supplied each day before serving fresh one. The feed conversion ratio was also calculated by dividing feed intake by weight gain. In the last week of feeding trial, a nutrient digestibility trial was conducted using the total collection method. This was done in specially designed metabolism cages having separate watering and feeding troughs. One bird per replicate was selected and placed in a metabolism cage. The birds were allowed to adjust to the conditions in the cages for three (3) days after which total faecal collection was carried out for four days. Dietary feed was weighed and water was served *ad-libitum* daily for 4 days. Total droppings were collected for four days and oven dried daily at 80^o C using hot air oven (Gallenkamp 300-inch series) until a constant weight was obtained. The faeces from each treatment were bulked and used for proximate analysis at the Department of Animal Production Laboratory using the procedure of AOAC (2000).

Data Analysis. All data generated were analysed using one-way analysis of variance (ANOVA) and where significant differences occurred, the means was separated using Duncan Multiple Range Test as contained in the SAS package (2015), version 15.0.

RESULTS AND DISCUSSION

The results of the effect of replacement of maize with sun- dried pineapple and orange peels meal-based diets was presented in **Table 3.** The results showed that only the feed conversion ratio (FCR) was influenced ($p<0.05$) by the peel meal-based diets. The feed conversion ratio results showed that birds on T1, T2 and T3 treatments has similar ($p>0.05$) values. Birds on T2, T3 and T4 treatments also had similar ($p>0.05$) values. However, bird on T1diet had better ($p>0.5$) feed conversion ratio than those of T4 treatment. The utilization of sun-dried orange and pineapple peels as a replacement for maize depressed growth of broiler chickens and this negative effect showed that sweet orange and pineapple peels as processed in this study still have a low feed value. It had been reported that sweet

orange and pineapple peels has higher crude fibre content than maize (Oluremi *et al*., 2007). In addition, Nicolakakis, *et al, (*1999) and Ahaotu and Ekenyem (2009) observed that higher dietary fibre depresses weight gain in broiler chickens. The results of the effect of the experimental diets on nutrient digestibility of broiler chickens is presented in **Table 4.** The results showed that dry matter, ash and NFE (Nitrogen free extract) digestibility were influenced ($p<0.05$) by the peels bases diets. However, the crude fibre digestibility was not influenced ($p<0.05$) by the dietary treatments. The dry matter digestibility results showed that birds on T2 and T3 diets had similar ($p>0.05$) values. Birds on T4 treatment had highest dry matter digestibility (83.55 %) value, the least was recorded by birds on T3 diet (78.78 %). The crude protein digestibility values ranged between 69.39 % and 76.22 %. The birds on T1, T3 and T4 had similar ($p>0.05$) values. Similarly, birds on T2, T3 and T4 also had similar ($p>0.05$) values. However, birds on T1 diet had higher ($p<0.05$) CP digestibility. The ash content digestibility ranges from 44.52 % and 64.01 %. The ash content digestibility results showed that birds on T1 and T4 diets had similar ($p>0.05$) values; birds on T2 and T3 diets also had similar. However, birds on T1 and T4 had higher ($p<0.05$) ash digestibility value than birds on T2 and T3 diets. The NFE digestibility results showed that birds on diet T4 had the higher ($p<0.05$) value as compared to others treatments Birds on T1 and T2 had similar ($p>0.05$) values, however, they had higher value than bird on T3 diets. The ether extract digestibility result ranges between 87.57% and 89.51%. Birds on T1, T3 and T4 diets had similar ($p>0.05$) values, birds on T2, T3 and T4 diets also had similar ($p>0.05$) values. However, birds on T1 diet had the highest EE while the least was recorded by birds on T2 diet The result of this study is in line with the observation of several researchers (Rao *et al*., 2001; Adeyemi *et al*., 2008) who observed significant differences in the digestibility of all nutrients when fed maize, millet and sorghum as the main source of energy in broilers diets. However, it does not agreement with the report of Hon *et al*. (2009), which stated no significant difference was found in growth performance after 20% dried sweet orange (Citrus sinensis) pulp meal was added in rabbit feeds

Table 1. Composition of Experimental Diets for Broiler Birds Under a Single Phase feeding.

Ingredients	T1(kg)	T2(kg)	T3(kg)	T4(kg)
Maize	51.00	46.00	46.00	46.00
Maize offal	9.00	9.00	9.00	9.00
Ground nut cake	17.00	17.00	17.00	17.00
Full fat soya	14.00	14.00	14.00	14.00
Fishmeal(imported	3.00	3.00	3.00	3.00
Orange peel	0.00	0.00	5.00	2.50
Pineapple peel	0.00	5.00	0.00	2.50
Limestone	2.00	2.00	2.00	2.00
Bone meal	2.00	2.00	2.00	2.00
Palm oil	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25
*Vit/min Premix	0.25	0.25	0.25	0.25
L-Lysine	0.25	0.25	0.25	0.25
Dl-Methionine	0.25	0.25	0.25	0.25
Total	100	100	100	100
Calculated analysis				
% Crude protein	20.52	20.07	20.07	20.07
ME/Kcal/kg	3089.37	2917.02	2917.02	2917.02
% Ether extract	7.00	6.81	6.81	6.81
% Crude fibre	4.05	3.94	3.94	3.94
% Calcium	1.45	1.45	1.45	1.45
% Phosphorus	0.45	0.45	0.45	0.45
% Lysine	1.12	1.12	1.12	1.12
% Meth + Cys	0.61	0.59	0.59	0.59

Vitamin and mineral premix. Vitamin A 1500 IU, Vitamin D 300 IU, Vitamin E 3.00, Vitamin K 0.25 g, Thiamine 0.2 mg, Riboflavin 0.6mg, Pantothenic acid 1.00 mg, Pyridoxine 0.4999 mg, Niacin 4.00 mg, Vitamin B12 0.002 mg, Folic acid 0.10 mg, Biotin 0.008 mg, Choline chloride 0.05g, Antioxidant 0.012 g, Manganese 0.0096 g, Zinc 0.0060 g, Copper 0.0006g, Iodine 0.006 g, Iodine 0.00014 g, Selenium 0.024, Cobalt 0.004 mg.
Keys: T1= Control, T2 = Pineapple peels waste, T3 = Orange peels waste and T4 = Mixtures of orange and pineapple peels waste
ME = Metabolizable energy, meth = methionine and cys = cystein)

Table 2 Proximate Composition of Orange and Pineapple Peels

Parameters	SDOP	SDPP	MPO
Moisture content	9.20	8.20	8.50
Ash Content	6.01	6.10	6.00
Crude Fibre	2.10	3.50	1.50
Crude Protein	7.00	5.60	6.90
Ether Extract	5.00	3.00	5.00
NFE	70.69	74.60	72.10
Energy(Kcal/kg)	3138.15	3061.20	3183.80

SDOP (Sun-dried orange peel), SDPP (sun-dried pineapple peel) MPO (Mixture of pineapple and orange peels) and NFE (nitrogen free extract)

Table 3. Growth Performance of Broiler Chicken Fed Sun-dried Orange and Pineapple Peels Based Diets Under Single Phase Feeding regime

	Treatments					
Parameters	T1	T2	T3	T4	SEM	LS
Initial Weight (g)	37.83	38.30	38.03	37.95	0.114	Ns
Final Weight (g)	1041.25	997.08	916.42	967.19	25.253	Ns
Total Weight (g)	1003.43	958.78	878.40	929.24	25.251	Ns
Daily Weight (g)	14.33	13.70	12.55	13.28	0.361	Ns
Daily Feed Intake(g)	33.38	34.21	32.41	35.04	0.705	Ns
FCR	2.34^{b}	2.52^{ab}	2.58^{ab}	2.64^{a}	0.456	*

[ab] Means on the same row having different superscripts are significantly different (P<0.05)
SEM: = Standard Error of Mean, LS=level of significant, FCR = (Feed conversion ration).

Table 4. Apparent Nutrient Digestibility of Broiler Chicken fed Sun-dried Orange and Pineapple Peels Based Diets Under Single Phase Feeding

	Treatments (%)					
Parameters	T1	T2	T3	T4	SEM	LS
Dry Matter	83.03^{b}	78.96^{c}	78.78^{c}	83.55^{a}	0.839	*
Crude Protein	76.22^{a}	69.39^{b}	74.10^{ab}	71.53^{ab}	1.087	*
Ash	59.12^{a}	44.52^{b}	47.91^{b}	64.01^{a}	3.119	*
Crude Fibre	63.30	54.86	62.12	56.28	1.623	Ns
NFE	93.26^{b}	92.83^{b}	88.26^{a}	95.89^{c}	1.063	*
Ether Extract	89.51^{a}	87.57^{b}	89.04^{ab}	88.78^{ab}	0.312	*

[abc] Means on the same row having different superscripts are significantly different (P<0.05)
SEM: = Standard Error of Mean,
NFE: = (Nitrogen free extract)

CONCLUSION: Base on the result of this study, the dietary inclusion of pineapple(PP) and orange(OP) peels does not depress growth below the acceptable range of weight. It was concluded that broiler birds could tolerate up to 5 % dietary levels of OP, PP meal and their mixture (MPO). without adverse effect. However, further research is needed to assess the effects of SDOP (Sun-dried orange peel) and SDPP (Sun-dried pineapple peel) to improve it suitability as feed resource.

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