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NUTRITIVE VALUE OF RIPE AND UNRIPE (GREEN) PLANTAIN PEELS (*Musa paradisiaca)* FOR BROILER CHICKEN

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Target Audience: Nutritionists, farmers, feed millers

ABSTRACT

The nutritive value of dried plantain peel (DPP) (Musa paradisiaca), ripe and unripe, was studied in a feeding trial with broiler chicken. The DPP was included in the diets to replace maize in iso-nitrogenous and iso-caloric diets with 22% crude protein (CP) and 14.3 MJ metabolizable energy (ME) per kg diet in the starting phase and 18% CP and 14.0MJ/kg diet in the finishing phase. Two hundred and sixteen day-old Aboracres chicks were assigned to nine dietary treatments in a 2 X 4 factorial design with 2 levels of ripeness (Unripe, ripe) and 4 inclusion levels of DPP in the diets (7.5, 15, 22.5, 30%) and a control diet without DPP. The experiment lasted 8 weeks. Unripe DPP reduced ($P < 0.05$) feed consumption at the starting phase and final liveweight, weight gain and feed consumption at the finishing phase. Dressing percentage, pluck weight, relative back weight were increased ($P < 0.05$) by the unripe DPP while ripe DPP increased ($P < 0.05$) relative weights of drumstick, wings, breast and thighs. The 22.5 and 30% inclusion levels of DPP (ripe and unripe) in the diets depressed ($P < 0.05$) weight gain and feed consumption at the starting phase and weight gain at the finishing phase. The results show that DPP could be included in broiler diet up to 15% while ripeness improved the performance of the birds.

Key words: Nutritive value, plantain peel, ripe, unripe, broiler, performance

DESCRIPTION OF PROBLEM

Maize constitutes the bulk of energy source used in compounding concentrate rations for various classes of livestock in different regions of the world. The current prohibitive prices of maize and the great diversity of uses for which they are put, stemming directly from their demand as stable human foods in many areas of developing world and as industrial raw materials, threaten more than ever before the potentials for increasing animal protein production.

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The future for efficient and profitable production of meat from pigs, poultry and rabbits would therefore depend on finding cheaper alternative sources of energy not directly required as components of human diets. The peels from plantain (*Musa paradisiaca*) is a by-product not directly utilizable by human. Of the 28.3 million tonnes of plantain produced world wide, 69.4% is destined for human consumption, 11.1% processed and 8% fed to livestock. More than 6% of this world volume is produced and consumed in Central and Western. Africa (1).

Ripe plantain peel is more readily digested than the green peels (2). It was reported that dried plantain peels can serve as direct replacement for maize in the diet of rabbit without any impediment in their efficiency of growth (3,4) while there is optimum production with 5% replacement value of plantain peels for maize on layer performance (5).

This experiment was conducted to determine the effects of ripe and unripe plantain peels as replacements for maize on the performance and carcass characteristics of broiler chickens.

MATERIALS AND METHODS

Experimental design

Chickens: Two hundred and sixteen day-old Aboracres broiler chicks of mixed sexes were weighed and randomly allotted to nine treatments of 24 birds per treatment. Each treatment was further sub-divided into three replicate groups. The birds were fed and watered *ad libitum*. Routine immunization and necessary medication were administered for the well-being of the birds. The birds were kept in deep-litter floored pens.

Diets: Plantain peels collected 24 hours after peeling from a plantain chip factory in Lagos were sun-dried for 5 days and ground in a hammer mill. Samples of the dried plantain peel were analysed for proximate chemical composition (6). Based on the result of the chemical analysis, nine experimental diets were formulated such that the unripe (green) and ripe plantain peel meals were included at 7.5, 15, 22.5, and 30% respectively to replace maize (Table 1). Thus the experiment was a 2 X 4 factorial design with 2 levels of ripeness (unripe and ripe) and 4 inclusion levels of (7.5, 15, 22.5, 30%) and a control diet without DPP.

Record Collection

Performance. Weekly live weight and feed consumption measurements were recorded on the last day of every week and before the morning feeding.

Gross Carcass Composition. At the end of the feeding period (eight weeks) feed was withheld overnight and two birds per replicate were randomly selected and slaughtered for carcass evaluation.

Analytical techniques Test ingredients and diets were analysed for their proximate constituents using the methods of A.O.A.C. (6). Gross energy was determined using a Gallenkamp oxygen bomb calorimeter. Mineral analysis were made by methods of Grueling (7).

Table 1: Gross composition of experimental diets (g/kg)

Diets	1	2	3	4	5	6	7	8	9
DPP inclusion	0	7.5	15	22.5	30	7.5	22.5	22.5	30
Maize	515.5	440.0	365.0	290.0	215.0	440.0	365.0	290.0	215.0
	(515.5)	(440.0)	(365.0)	(290.0)	(215.0)	(440.0)	(365.0)	(290.0)	(215.0)
SBM	250.0	250.0	248.0	246.0	245.0	250.0	240.0	246.0	246.0
	(175.0)	(175.0)	(170.0)	(171.0)	(170.0)	(175.0)	(173.0)	(1714.0)	(170.0)
Maize offal	130.0	130.0	134.0	134.0	135.0	130.0	132.0	134.0	135.0
	(240.0)	(240.0)	(245.0)	(244.0)	(245.0)	(240.0)	(242.0)	(244.0)	(245.0)
Fish meal	60.0	60.0	60.0	60.0	60.0	60.0	60.0	o0.0	60.0
	(925.0)	(925.0)	(25.0)	(25.0)	(25.0)	(25.0)	(25.0)	(25.0)	(25.0)
RPP	-	75.0	150.0	225.0	300.0	-	-	-	-
	(75.0)	(150.0)	(225.0)	(300.0)	75.0	150.0	225.0	300.0	
UPP	-	-	-	-	-	(75.0)	(150.0)	(225.0)	(300.0)
Bone meal	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)	(30.0)		
Oyster shell	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
Salt	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
Premix*	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)	(2.5)
Determined Chemical Composition (% Dry Matter)									
Dry Matter	916.0	927.0	93.0	916.0	922.0	920.0	930.0	916.0	924.0
Crude	(915.0)	(915.0)	(918.0)	(914.0)	(917.0)	(918.0)	(910.0)	(912.0)	(918.0)
Protein	216.4	216.4	220.0	220.7	222.2	217.8	219.2	220.87	221.9
Crude fibre	(181.5)	(182.4)	(183.1)	(183.4)	(184.6)	(182.2)	(182.9)	(183.4)	(184.1)
	36.4	51.2	53.8	56.4	57.0	50.2	53.3	56.4	57.7
Fat	(35.8)	(50.0)	(51.8)	(50.8)	(54.4)	(50.4)	(52.4)	(56.8)	(57.2)
	35.7	36.0	35.9	36.2	36.1	35.9	36.1	35.9	36.2
Gross energy	(35.6)	(35.6)	(35.9	(35.9)	(36.1)	(35.7)	(36.20)	(35.9)	(36.1)
(MJ/kg)	14.51	14.40	14.30	14.30	14.26	14.37	14.32	14.25	11.23
	(14.12)	(14.12)	(14.00)	(14.00)	(13.96)	(14.06)	(14.03)	(13.99)	(13.92)

RPP = ripe plantain peel: UPP = unripe plantain peel

Data for finisher diets are indicated in parentheses

*Provided per kg diet; 12500 IU Vitamin A, 2500 IU Vitamin D_3 40mg Vitamin E, 6mg Vitamin B_2, 35mg Vitamin B_3, 35mg Vitamin B_6, 300mg Choline chloride, 100mg Manganese, 50mg Iron, 2.0mg Copper, 155mg Iodine, 0.1mg Selenium, 2.5mg Vitamin K_3, 10mg Calcium pantothenate, 0.025mg Vitamin B_{12}, 15mg Zinc, 0225mg cobalt, 2.0mg Vitamin B_1, 0.05mg Biotin, 1.00 Folic acid.

RESULTS AND DISCUSSION

The chemical composition of DPP (Table 2) compared favorably with maize except in crude fibre and ether extract (3,10) It was higher in Ca and P. The ripe DPP was higher than the unripe (green) DPP in all the nutrients except the crude protein (11).

Table 2: Proximate composition of the test ingredients (g/kg)

	Unripe	Ripe
Dry matter	865.0	870.0
Crude protein	98.3	101.0
Crude fibre	56.3	55.3
Ash	142.3	131.5
Calcium	131.6	127.6
Phosphorous	9.6	8.0
Gross energy	3.2	2.9
	14.54	4.16

The results showed that the level of ripeness significantly ($P < 0.05$) affected feed consumption at the starter phase while weight gain and feed consumption were significantly ($P < 0.05$) affected at the finisher and combined phases (Tables 3 and 4). Birds fed unripe DPP had the highest ($P < 0.05$) dressing percentage, relative plucked and back weights while birds on the ripe DPP were best ($P < 0.05$) in relative drumstick, wings, breast and thigh weights (Tables 5 and 6) Inclusion levels of DPP significantly ($P < 0.05$) depressed weight gain and feed consumption at the starter and combined phases, while weight gain decreased ($P < 0.05$) with increased level of DPP in the diets at the finisher phase. Dressing percentage, relative back and liver weights increased ($P < 0.05$) with inclusion of DPP in the diets.

Generally, ripe DPP increased ($P < 0.05$) the feed consumption in both phases and the combined phase. This may be attributed to the sweetness of the ripe peel due to the presence of sucrose, glucose and fructose (3). The unripe (green) DPP has been found to contain high content of active tannins which is known to decrease palatability and voluntary intake in pigs (12). The higher ($P < 0.05$) weight gain recorded with the ripe DPP may have been due to the higher nutrients and minerals in ripe DPP (11) coupled with the higher feed consumption as a result of better palatability. The significant ($P< 0.05$) decrease in weight gain and feed consumption of the birds with increased level of DPP in the diets may have been due to the palatability of DPP, high fibre and low energy content of DPP diets. Tannin is known to decrease palatability (12).

Table 3: Performance characteristics of broilers fed the experimental diets

Type / Level %	RIPE PEELS (RPP)				UNRIPE PEELS (UPP)				CONTROL	SEM ±
	7.5	15.0	22.5	30.0	7.5	15.0	22.5	30.0	0.0	
Starting phase (1-28days)										
Initial liveweight (g/bird)	45	45	45	45	45	45	45	45	45	0.0
Final liveweight (g/bird)	665^{a}	620^{b}	620^{b}	585^{c}	580^{c}	650^{a}	610^{b}	505^{b}	665^{a}	8.33
Weight gain (g/bird)	620^{a}	575^{b}	575^{b}	540^{b}	535^{b}	605^{a}	565^{b}	460^{c}	620^{a}	6.19
Feed consumption (g/bird)	1640^{a}	1600^{a}	1600^{a}	1560^{b}	1440^{b}	1596^{a}	1560^{b}	1400^{b}	1700^{a}	3.01
Feed conversion ratio	2.64	2.78	2.78	2.89	2.69	2.64	2.72	3.04	2.74	0.30
Finishing phase (29-56 days)										
Liveweight increase (g/bird)	1545$_{a}$	1520	1365^{d}	1360^{c}	1510^{a}	1430^{c}	1300^{d}	1245^{c}	1645^{a}	30.01
Weight gain (g/bird)	890	900	780	780	860	820	740	740	980	4.26
Feed consumption (g/bird)	3080	2960	2960	2920	3080	2840	2840	2920	3280	36.42
Feed conversion ratio	3.14	3.29	3.79	3.74	3.35	3.46	3.84	3.94	3.35	0.22
Combined phases (0-56 days) Liveweight increase	1600	1475	1320	1315	1365	1385	1255	1200	1660	31.11
(g/bird)	4860	4560	4520	4360	4320	4280	4240	4320	5000	20.80
Feed consumption (g/bird)	2.93	3.09	3.42	3.31	3.16	3.09	3.98	3.60	3.13	0.13
Feed conversion ratio										

a, b, c, d: Means without a common superscript differ significantly. ($P < 0.05$)

Table 4: Effect of degrees of ripeness and inclusion of plantain peels on performance of broilers

	Degree of ripeness			Inclusion level of DPP					
	Unripe (U)	Ripe (R)	SEM ±	0	7.5	15	22.5	30	SEM ±
Starting phase (0-28days)									
Initial liveweight (g/bird)	45	45	0.00	45	45	45	45	45	0.0
Final liveweight(g/bird)	584.3	617.5	19.00	665	657.5	615	572.5	542.5	1.82
Weight gain (g/bird)	536.3	567.5	1.11	620^{a}	512.5^{a}	570^{ab}	527.5^{bc}	497.5^{c}	2.36
Feed consumption (g/bird)	1489^{b}	1560^{a}	10.03	1700^{a}	1618^{a}	1580^{a}	1480^{b}	1420^{c}	7.33
Feed conversion ratio	2.78	2.75	0.02	2.74	2.64	2.77	2.81	2.85	0.04
Finishing phase (29-56)									
Liveweight increase (g/bird)	1371^{b}	1472.5^{a}	1088	1645^{a}	1577.5^{a}	1495^{ab}	1332.5^{bc}	1320.5^{c}	15.42
Weight gain (g/bird)	790^{b}	86.0^{a}	2.04	980^{a}	920^{a}	8.80^{ab}	760^{c}	760^{c}	4.13
Feed consumption (g/bird)	2870^{b}	2980^{a}	5.67	3280	2980	2900	2920	2920	0.89
Feed conversion ration	3.63	3.47	0.04	3.35	3.24	3.34	3.82	3.84	0.03
Mortality (%)									
Combined phases									
Liveweight increase (g/bird)	1326.3^{b}	1427^{a}	2.32	1600^{a}	1532.5^{a}	50^{b}	1287.5^{c}	1257^{c}	11.28
Feed consumption (g/bird)	420^{b}	453^{a}	1.94	4980^{a}	4598^{b}	4598^{b}	4480^{b}	4480^{b}	2.02
Feed conversion ration	3.32	3.17	0.03	3.11	3.09	3.13	3.40	3.40	0.02
Mortality (%)									

Table 5: Gross Carcass evaluation of birds fed the experimental diets

Type Level (%)	RIPE PEELS (RPP)				UNRIPE PEELS (UPP)				CONTROL	SEM ±
	7.5	15.0	22.5	30.0	7.5	15.0	22.5	30.0	0.0	
Mean live Weight (kg)	1.39	1.24	1.18	1.02	1.37	1.27	1.16	1.05	1.47	0.06
Dressed weight (kg)	0.89	0.88	0.88	0.75	1.11	1.06	0.97	0.87	1.07	0.08
Dressing %	62.5^{c}	70.97^{b}	72.03^{b}	73.53^{b}	81.02^{a}	83.46^{a}	83.62^{a}	82.86^{a}	72.79^{b}	1.11
Plucked weight (kg)	1.29^{a}	1.14^{b}	1.08^{bc}	0.92^{c}	1.30^{a}	1.21	1.11^{b}	1.00^{c}	1.38^{a}	0.11
Plucked weight (%)	92.81	91.94	91.53	92.20	94.89	95.28	95.69	95.24	93.88	1.10
Carcass composition (%)										
Drumstick	10.85^{b}	11.40^{a}	12.04^{a}	11.96^{a}	9.23^{c}	9.92^{c}	9.91^{c}	10.0^{c}	10.14^{bc}	1.0
Wing	10.85^{b}	12.28^{a}	12.04^{a}	13.04^{a}	8.46^{c}	8.26^{c}	8.11^{c}	9.00^{c}	9.42^{c}	0.61
Breast	17.83^{c}	19.30^{b}	20.37^{a}	20.65^{a}	16.92^{cd}	17.36^{c}	15.32^{d}	16.00^{b}	18.84^{c}	0.33
Back	10.08^{c}	11.40^{c}	12.04^{c}	10.87^{c}	21.54^{a}	22.31^{a}	18.92^{b}	18.00^{b}	12.32^{c}	6.48
Neck	5.43^{a}	6.14^{a}	5.56^{a}	6.52^{a}	3.85^{b}	4.13^{b}	3.60^{b}	4.00^{b}	3.62^{b}	0.46
Shanks	3.88	4.39	3.70	4.35	3.85	4.13	4.50	4.00	4.35	0.03
Head	3.88	4.39	4.63	4.35	3.85	3.31	3.60	4.00	4.35	0.02
Thighs	12.40^{b}	13.16^{b}	13.89^{b}	15.22^{a}	9.23^{c}	9.09^{c}	9.91^{c}	10.00^{c}	10.87^{c}	2.12
Liver	3.10	3.51	3.70	4.35	3.85	3.31	3.60	4.00	2.90	0.12
Heart	1.55^{a}	0.88^{b}	0.93^{b}	1.09^{a}	0.77^{c}	0.83^{b}	0.90^{b}	1.00^{b}	0.72^{c}	0.08
Gizzard	3.8	4 39	3.70	3.26	3.85	4.13	4.50	4.00	4.35	0.72

a,b,c,d: Means without a common superscript differ significantly ($P < 0.05$).

Table 5: effect of degrees of ripeness and inclusion of plantain peels on carcass yield of broilers

	Degree of ripeness		SEM ±	Inclusion level of DPP (%) (Ripe and Unripe)					SEM ±
	Unripe (U)	Ripe (R)		0	7.5	15.0	22.5	30.0	
Mean live Weight (kg)	1.21	1.21	0.00	1.47[a]	1.38[b]	1.26[c]	1.17[d]	1.04[c]	0.02
Dressed weight (kg)	1.00[a]	0.84[b]	0.02	1.07[a]	0.99[ab]	0.97[ab]	0.91[b]	0.81[c]	0.05
Dressing %	82.74[a]	69.78[b]	4.21	72.79[b]	71.81[b]	77.22[a]	77.83[a]	78.20[a]	0.33
Plucked weight (%)	1.16	1.11	0.05	1.38[a]	1.30[b]	1.18[c]	1.10[d]	0.96[d]	0.16
Plucked weight (kg)	95.28[a]	91.62[b]	0.78	93.88	93.85	93.61	93.61	92.72	0.03
Carcass composition (%)									
Drumstick	9.77[b]	11.56[a]	0.13	10.14	10.04	10.66	10.98	10.98	0.04
Wing	8.46[b]	12.05[a]	0.96	9.42	9.66	10.27	10.08	11.02	0.12
Breast	16.40[b]	19.54[a]	0.68	18.84	17.38	18.33	17.85	18.33	0.22
Back	20.19[a]	11.10[b]	6.60	12.32[b]	15.81[a]	16.86[a]	15.48[a]	14.44	0.04
Neck	3.90	5.91	0.56	3.62	4.64	5.14	4.58	5.26	0.08
Shanks	4.12	4.08	0.02	4.35	3.87	4.26	4.10	4.18	0.03
Head	3.69	4.31	0.04	4.35	3.87	3.85	4.12	4.18	0.06
Thighs	9.56[b]	13.67[a]	0.13	10.87	10.82	11.13	11.90	12.61	0.11
Liver	3.69	3.67	0.01	2.90[c]	3.48[b]	3.41[b]	3.65[b]	4.18[a]	0.02
Heart	0.88	1.11	0.04	0.72	1.16	0.86	0.92	1.05	0.21
Gizzard	4.12	3.81	0.12	4.35	3.87	4.26	4.10	3.63	0.07

a, b, c. Means without a common superscript differ significantly ($P < 0.05$)

The variation observed in the performance especially weight gain, largely explains the variation in the gross carcass evaluation (Table 5).

When the influence of ripeness (ignoring inclusion level) of DPP was considered on carcass evaluation (Table 6), it was evidenced that ripe DPP supported better weights of drumstick, wing, breast and thighs. The breast muscles and drumstick are the most economically important portions of the carcass composition and also provide the greatest portions of edible meat in broilers (13). Dressed weight and plucked weight decreased with increased level of DPP in the diet, which is a reflection of the mean live weight. The increased liver weight with level of DPP in the diet may be due to the increased activity of this organ to deal with the tannin content of DPP.

CONCLUSION AND APPLICATIONS

The results of this study indicate that ripening improved the nutritive value of plantain peel for broiler chicken and that plantain peel may be included in unripe (green) or ripe form at a level of 15% in the diets of broiler chicken without significantly affecting their performance.

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