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EFFECTS OF YAM AND IRISH POTATO PEELS AS ALTERNATIVE ENERGY SOURCES ON CARCASS CHARACTERISTICS OF GROWING RABBITS IN SEMI-ARID MAIDUGURI, NIGERIA

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ABSTRACT

Thirty (30) rabbits (Dutch × New Zealand Whites) with an average weight of 450 g were used in a 56 - day feeding trial to evaluate yam peel meal (YPM) and Irish potato peel meal (IPPM) on carcass characteristics of growing rabbits in semi-arid Maiduguri, Nigeria. The animals were assigned to six dietary treatments in a Completely Randomized Design (CRD) and divided into five replicates. They were fed with diets containing 100% maize, 50% maize+50% YPM, 50% maize+50% IPPM, 50% YPM +50% IPPM, 100% YPM and 100% IPPM designated as diets A, B, C, D, E and F respectively. Slaughter weight and dressed weight were similar (P> 0.05) to the control except diets E (100% YPM) and F (100% IPPM that were significantly (P < 0.05) lower than the control. Racks weights were similar(P>0.05) to the control diet except diet B (50% maize + 50% YPM) which differ (P< 0.05) from diet C. Loins and thighs weights were similar (P> 0.05) to the control diet except for diet D (50% YPM + 50% IPPM). The heart did not differ significantly (P> 0.05) among the treatments. The weight of liver and kidneys were similar among the treatments (P> 0.05). It was concluded that replacement of maize with YPM and IPPM in the diet of growing rabbits had no adverse effects on carcass yield and organs weight of growing rabbits.

Keywords: Yam peel; Irish potato peel; Carcass yield and Rabbit

INTRODUCTION

Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria (Ajala and Balogun, 2004). It has immense potentials and good attributes which include high growth rate, high efficiency in converting forage to meat, short gestation period, high prolificacy, relatively low cost of production, high nutritional quality of meat which includes low fat and cholesterol levels. The meat also has a high protein level of about 20.8% and its consumption is bereft of cultural and religious biases (Ndor *et al*., 2009). Animal protein contains more essential amino acids required to meet human nutritional needs than plant protein. Rabbit industry is growing in many countries today, yet feeding problems

associated with poultry and pig farming are now being encountered by rabbit breeders who depend solely on pellets and concentrates for their animals. Thus, there is urgent need to explore cheaper alternative feed resources especially by-products of crops (Igwebuike, 2001; Faniyi, 2002). Some of these potential alternatives include, yam peels, potato peels and cassava peels. The white or Irish potato (*Solanum tuberosum*), also called the "earth apple"; is grown in nearly all parts of the tropical and subtropical world and in warmer areas of the temperate regions (Ogunjobi *et al*., 2005). The peels are by-products of kitchen waste which needs to be explored by researchers. Anon (1985) and Brown (2007) reported that potato peels are rich in phytonutrients, carbohydrates, high in starch (8 - 28%) but with only about 1 - 4% protein. Yam belongs to the Genus; *Dioscoreae*, species: (*D. rodundata, D. alata*). Yam peels are waste or by-products of processing when the tubers are being prepared for human use. The peels contain a reasonably high level of energy (2701 kcal/kg) and can be fed to livestock as a component of their diet (Edache *et al*., 2012). This study seeks to evaluate the effect of yam peel meal (YPM) and Irish potato peel meal (IPPM) on carcass yield and organ weight of growing rabbit in semi-arid Maiduguri, Nigeria.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Livestock and Research Farm, Department of Animal Science, University of Maiduguri, Borno State. Maiduguri is located within the Sahelian (semi-arid) region of West Africa on an elevation of 354 m above sea level in the North-eastern part of Nigeria on Latitude 11.51^0North and Longitude 30.05^0 East (NOAA, 2016). Characterized by three distinct seasons namely Wet (June-September), dry cold (October-January) and dry hot (February-May). The hottest season is between April and May, which is characterized with bright sunny day and the atmospheric temperature fluctuates between 40-45^0C. During the rainy season, the temperature may drop to about 30^0C or less. The peak of rainfall is August where precipitation may exceed 198.6 mm while the relative humidity may reach up to about 45 % in the wet season which drops to about 5 – 10 % during the dry cold season (NOAA, 2016).

Management of the Experimental Stock

Thirty (30) rabbits (Dutch × New Zealand Whites) of 5-6 weeks old with an average weight of 450 g were randomly allocated to six treatments in group of five rabbits per treatment using Completely Randomized Design (CRD). The stocks were obtained from small-scale producers in Funakaye L.G.A. of Gombe State. The rabbits were housed in cages measuring 36cm × 36cm × 45cm (width × length × height). The cages were slightly raised above the floor for easy sweeping of faeces and cleaning. Plastic drinkers (cups) and improvised metallic feeding troughs were provided in each cage. The drinkers were washed daily. Water was supplied *ad-libitum* during the experimental period.

Experiment Diets

Six diets were formulated using the following ingredients: maize, YPM, IPPM, wheat offal, groundnut cake (GNC), groundnut haulms (GNH), fish meal (FM), limestone, salt and

premix. All these ingredients were purchased within Maiduguri. The compositions of the experimental diets are presented in Table 1.

Table 1: Composition of the experimental diets

Ingredient (%)	Treatment Diets					
	A	B	C	D	E	F
Maize	34.00	17.00	17.00	0.00	0.00	0.00
YPM	0.00	17.00	0.00	17.00	34.00	0.00
IPPM	0.00	0.00	17.00	17.00	0.00	34.00
Wheat offal	17.00	17.00	17.00	17.00	17.00	17.00
GNC	27.00	27.00	27.00	27.00	27.00	27.00
GNH	16.50	16.50	16.50	16.50	16.50	16.50
Fish meal	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	2.00	2.00	2.00	2.00	2.00	2.00
Salt	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
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Chemical Composition						
ME(Kcal/kg)	3100.72	2932.50	3092.40	3052.24	3119.62	3001.10
CP (%)	22.00	20.64	21.46	21.01	20.27	21.91
CF (%)	9.10	11.20	11.26	12.36	11.30	12.42
EE (%)	2.76	2.44	2.64	1.71	2.12	1.83

YPM- Yam peel meal, IPPM- Irish potato peel meal, GNC- Groundnut cake, GNH- Groundnut haulms, ME- Metabolizable energy, CP- Crude protein, CF- crude fibre, EE – ether extract

Chemical Analysis

The crude protein (CP), crude fibres (CF), ether extract (EE), and ash components of the dried samples were determined according to the procedures of AOAC (1990). The proximate analysis was conducted for YPM, IPPM and the experimental diets.

Data Collection

Carcass and primal cut yield and organs weight were taken. Three rabbits were randomly selected using balloting technique from each treatment. Before slaughter, the rabbits were fasted for 12 hours in order to reduce the stomach and intestinal contents. All the animals were weighed before and after slaughter using digital scale (0g - 5000 g capacity, Metler mt-5000 d Electronic Balance). The slaughtered rabbits were dressed by removing the head, skin, feet and visceral organs. The dressed carcasses were expressed as a proportion of the slaughter weight to obtain the dressing percentage as shown below. The body components and organs weight were also expressed as percentage of slaughter weight using the formula below.

$$Dressing\ percentage = \frac{\text{Dressed weight}}{\text{Slaughter weight}} \times 100$$

Data Analysis

The data collected were subjected to one-way analysis of variance (ANOVA). Significant difference observed among treatment means were separated by Duncan's Multiple Range Test (DMRT) using SPSS version 21.0 (SPSS, 2012).

RESULTS AND DISCUSSION

Proximate Composition of the Experimental Diets, YPM and IPPM

The proximate composition of the experimental diets, YPM and IPPM are presented in Table 2. The results obtained for DM ranges from 94.10 to 96.00 %. The CP ranges from 19.42 - 21.33% CP. The results obtained for CF in the diets increased as the level of maize decreased in the diets. The control diet A has the lowest value of 8.75% CF, while diet F (100% IPPM) has the highest value of 12.32% CF. The fat content of the diets falls within the of range 1.4 to 2.1%. The control diet has the lowest fat content of 1.40%, while diet E has the highest content of 2.10%. The NFE values ranges from the 55.88 to 62.16 for diet B and E respectively.

Table 2: Proximate composition of the experimental diets and test ingredients

Diets & Test Material	Components						
	DM	CP	CF	Fat	Ash	NFE	ME
A	95.90	21.33	8.75	1.40	2.00	61.72	3096.72
B	94.10	20.38	9.64	1.70	2.50	55.88	2875.50
C	96.70	21.28	10.54	1.30	2.16	61.28	3092.40
D	96.00	20.33	11.42	1.50	2.20	56.55	2952.24
E	96.00	19.42	10.52	2.10	2.65	62.16	3119.62
F	96.00	21.24	12.32	1.50	2.12	56.32	2918.10
YPM	95.00	4.38	7.20	2.28	1.60	78.87	3191.90
IPPM	96.40	9.72	12.50	1.10	1.10	71.96	3003.30

DM- dry matter, CP- crude protein, CF- crude fiber, EE- ether extract, NFE- Nitrogen-free extract, ME- Metabolizable energy, YPM- Yam peel meal and IPPM- Irish potato peel meal

The value obtained for CP in all the treatment falls within the range of nutrient requirements of growing rabbits. According to Moreki (2007), rabbits feed should contain 12 to 18% protein. The values were also superior to the values of 16.79 – 17.26% CP reported by Akinmutimi *et al*. (2006) who fed ripe plantain and YPM in the diets of weaner rabbits as replacement for maize. Moreover, Fielding (1991) recommended CP levels of 17.5% CP for satisfactory growth and reproduction of rabbits. The CF values obtained in all the treatments except diet F (100% IPPM) which is within the range are below the recommended levels of 12 - 14% CF advocated by Fielding (1991) for all-purpose rabbit diets. Furthermore, the values obtained for CF (8.75 - 12.32%) are superior to the report by Aknimutimi and Anakebe (2008) (6.61 - 7.11% CF) who fed yam and sweet potato peel meals to weaner rabbits in place of maize-based diet. The wide variation in CF value may probably be due to variation in tests ingredients and replacement level of test ingredients. The values for fat are below the desirable level of 3% fat by Omole *et al*. (2007) for sufficient need of rabbits. The lower values obtained for fat content could be due ingredients fault and may affect carcass yield.

The ash content of the diets ranges from 1.60 to 2.65 % ash. The results are contract the report by Akinmutimi *et al*. (2006) who fed ripe plantain and yam peels in the diets of weaner rabbits as replacement for maize. The proximate composition of YPM is similar to the report by (Omole *et al*., 2013) who fed yam peel as partial replacement for maize in the diet of juvenile snails (*Archachatina marginata*). The results for IPPM, especially crude protein of 3003.30 ME is close to that of maize (3096.72 ME). This makes it a potential alternative source for maize in the diet of rabbit. The metabolizable energy (ME) values ranges from 2875.50 to 3119.62 kcal/kg. The values are adequate for the need of growing rabbits.

Carcass Yield of Rabbit Fed Graded Levels of IPPM and YPM

The mean of dressed weight and primal cuts were expressed as a percentage of slaughter weight. Dressing percentage was obtained by expressing the dressed carcass as a percentage of slaughter weight as presented in Table 3. There were significant ($P < 0.05$) differences in all variables measured except shoulder. The results for slaughter weight and dressed weight were similar to the control diet (100% maize) except diets E (100% YPM) and F (100% IPPM) that were significantly ($P < 0.05$) lower than the control. Rack was similar among the treatments except diets B (50% maize + 50% YPM) compared to the diet A. Loin and thigh were similar to the control diet except diet D (50% YPM + 50% IPPM). Results of thigh weight showed diet C significantly ($P < 0.05$) among the treatments.

Table 3: Carcass yield of rabbit fed graded levels of IPPM and YPM

Variable	Treatments						
	A	B	C	D	E	F	SEM
Slaughter weight	1227.30^{ab}	1116.00^{bc}	1262.70^{a}	1151.70^{abc}	1091.70^{c}	1071.70^{c}	41.60*
Dressed weight	633.33^{a}	575.00^{ab}	600.00^{ab}	516.67^{ab}	483.33^{b}	483.33^{b}	40.28*
Dressing %	51.59^{a}	51.42^{a}	47.49^{ab}	41.95^{b}	46.63^{ab}	45.11^{ab}	2.08*
Shoulder	14.23	14.91	14.64	13.38	13.72	14.44	0.75^{NS}
Rack	3.77^{ab}	3.38^{b}	4.43^{a}	3.88^{ab}	3.69^{ab}	4.07^{ab}	0.24*
Loin	9.38^{ab}	8.41^{bc}	9.92^{a}	7.12^{c}	8.14^{b}	9.06^{ab}	0.45*
Thigh	17.61^{bc}	18.31^{bc}	20.82^{a}	15.41^{d}	17.36^{c}	18.75^{b}	0.42*

means in the same row bearing different superscripts differ significantly ($p<0.05$)
NS = Not significant ($p> 0.05$); * = significant ($p<0.05$); SEM = standard error of the means.

The high slaughter weight obtained in treatment D signifies the potentiality of YPM and IPPM as replacement for maize in the diet of rabbits. These may be due to high fiber levels of the diets. The values obtained for dressing percentage which range from 41.95 to 51.59% were lower to the values of 51.72 to 56.56% reported by Aknimutimi and Anakebe (2008) who fed yam and sweet potato peel meal to weaner rabbits in place of maize-based diet.The results for loin and thigh ranging from 7.12 to 9.92% and 15.41 to 20.82% were lower than the values of 27.90 to 37.30% and 24.03 to 37.05 % reported by Ayoola and Akinbanin (2011). They fed yam peel meal as replacement for maize to rabbits. The differences may be due to weather condition and differences in the slaughter weight and composition of the diets. However, diet E (100% YPM) shows superiority to other diets.

Organs Weight of Rabbit Fed Graded Levels of IPPM and YPM

Table 4 showed mean weight of internal organs expressed as a percentage of slaughter weight of growing rabbits fed graded levels of IPPM and YPM as replacement of maize. There were significant ($p < 0.05$) differences in all the parameters measured except the heart. The results for liver indicated that control diet has lower weight compared to diets B (50% maize + 50% YPM) and E (100% YPM). The values obtained for kidney were similar to the control diet.

Table 4: Organs weight (g) of rabbit fed graded levels of IPPM and YPM

Organs	Treatments						
	A	B	C	D	E	F	SEM
Liver	1.99^{b}	2.74^{a}	2.48^{ab}	2.37^{ab}	2.74^{a}	2.39^{ab}	0.21*
Kidney	0.81^{ab}	0.94^{a}	0.75^{b}	0.72^{b}	0.84^{ab}	0.87^{ab}	0.05*
Heart	0.18	0.27	0.24	0.32	0.19	0.19	0.06^{NS}
Lungs	0.62^{bc}	0.52^{c}	0.79^{a}	0.49^{c}	0.76^{ab}	0.84^{a}	0.05*
Spleen	0.04^{c}	0.043^{bc}	0.04^{c}	0.04^{c}	0.046^{ab}	0.050^{a}	0.0058*

means in the same row bearing different superscripts differ significantly ($p<0.05$)
NS = Not significant ($p> 0.05$); * = significant ($p<0.05$); SEM = standard error of the means.

The result pattern obtained for the liver is contrary to the work of Anugwa *et al*. (1998) who reported decreased in liver weight as levels of fiber increases in the diet. The difference may be due different variety of rabbit used for the experiments. The similarities observed in all the treatments for kidney indicates that all the experimental diets are free from toxic substances that may affect the kidney. The heart recorded non-significant difference, this is in agreement with the report by Akinmutumi *et al*. (2006) who reported same when weaner rabbits were fed with ripe plantain and yam peels as replacement for maize in their diet.

CONCLUSION

The result of the study indicates that YPM and IPPM, which are economically cheaper than maize, can be used successfully to replace maize in conventional rabbit diets without detrimental effects on the carcass yield and organs weight of growing rabbits in semi-arid Maiduguri. Based on the findings of this experiment, it is recommended to replace 50% maize with either 50% yam peel meal or 50% Irish potato peel meal or both in the diet of growing rabbits. Rabbit farmers in the semi-arid zone are encouraged to use YPM and IPPM as a replacement for maize in the diets of growing rabbits.

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