Tropical and Subtropical Agroecosystems

POTENTIAL OF BREAD FRUIT (*Artocarpus altilis*) AN ECOLOGICALLY FOREST BASED FEED RESOURCE IN RABBIT NUTRITION

[POTENCIAL DE A*rtocarpus altilis*, UN RECURSO ALIMENTICO FORESTAL, PARA LA NUTRICIÓN DE CONEJOS]

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SUMMARY

Productive response of rabbits fed with diets containing graded levels of sun dried breadfruit meal (SBFM) meal were studied using 80 weaner rabbits. Four dietary treatments were formulated: such that SBFM replaced maize weight for weight at 0%, 22.2%, 44.4% and 66.6% levels, respectively. Growth, nutrient digestibility, haematological indices, serum biochemistry, carcass yield and meat composition were evaluated. Rabbits fed with 22.2% maize replaced with SBFM recorded the highest (P<0.05) values for final live weight, weight gained, dry matter, crude protein, ether extract, crude fibre digestibility, chilled carcass weight, reference carcass weight and dressing out percentage. Meat from rabbits fed with SBFM based diets recorded higher (P<0.05) ash and Fe contents. Rabbits fed diets containing 66.7% maize replaced with SBFM recorded the highest (P<0.05) value of 16.20 g/dl and 102.50 x 10^{12}/L for haemoglobin (Hb) and red blood cell (RBC), respectively. It was concluded that SBFM could be used to replace maize at 22.2% in a rabbit concentrate without any adverse effect on growth response, nutrient digestibility, haematological indices, serum biochemistry and carcass yield.

Key words: Dressing out percentage; sun dried breadfruit; weaner rabbits.

RESUMEN

Se evaluó la respuesta productiva de conejos alimentados con dietas que contenía fruto seco del árbol del pan (SBFM). Se emplearon 80 conejos destetados de ambos sexos, los cuales fueron alimentados con dietas formuladas para que SBFM reemplazara el grano de maíz en 0%, 22,2%, 44,4% y 66,6% respectivamente. Se evaluó el crecimiento, digestibilidad de los nutrientes, índices hematológicos, bioquímica sanguínea, rendimiento de canal y composición de la carne fueron. Los conejos alimentados con 22,2% SBFM registraron la mayor (P<0.05) ganancia de peso vivo final y digestibilidad de la materia seca, proteína cruda, extracto etéreo, peso de la canal fría y rendimiento de canal. La carne de conejos alimentados con SBFM tuvo el mayor contenido de ceniza y Fe (P<0.05). Los conejos alimentados con 66,7% SBFM registraron los valores más altos (P<0.05) de Hb (16,20 g/dl) y eritrocitos (102,50 x 10^{12} /L). Se concluye que SBFM podría ser utilizado para reemplazar maíz hasta en 22,2% sin algún efecto adverso en el crecimiento, digestibilidad del alimento, índices hematológicos, bioquímica sanguínea y rendimiento de canal.

Palabras clave: Fruto seco del árbol del pan; gazapos; rendimiento de canal.

INTRODUCTION

Livestock production represents a major investment with important economic, nutritional and social implications for developing countries. The level of animal protein consumption, however, in these countries have been reported to be very low and, generally, influencing the health and well being of the ever increasing population (Bamgbose et al., 2002).

FAO (1996) reported that monogastric animals (pigs, rabbits and poultry) are the major source of meat supply representing 63 percent of all the meat consumed globally. However, McNitt et al., (1996) reported that rabbits can utilize low grain and high roughage diets. This attributes placed rabbit production as one of the targeted sector to focus in a bid to eliminate the prevailing tide of protein malnutrition in developing countries. However,

commercial intensive rabbit production is not totally hitch free due to the embedded cost of feeding. Conventional feedstuffs used in finished feed/concentrate production are costly as a result of stiff competition between man and livestock for grains and oil seeds (Ogbonna et al., 1993). It is then imperative to explore alternative feed ingredients which could bridge the gap.

Currently, efforts in livestock feeding are focused on increasing livestock feed base by adapting animal production system to locally available feed resources. Among the ecologically available forest based feed resources with good biomass production which can be converted into feed (for livestock) is the breadfruit (*Artocarpus altilis*) which is found in the wild (Achinewhu, 1982). It is a sub tropical fruit-bearing tree which stores mainly carbohydrates in its fruits. The plant occurs in the wild in Iran and Micronesia, while its secondary centre of diversity is Polynesia. It is commonly cultivated in several other tropical countries like West Indies, Ghana, Sierra Leone, Nigeria and Jamaica (Dailziel, 1955). Breadfruit produces fruit 2-3 times in a year (Tindal, 1965) and the number of fruits produced is very high (Soetjipto and Lubis**,** 1981). The fruit is aromatic, rich in latex and weighing up to 1-4 kg (Yamaguchi, 1983).

Quijano and Arango (1979) reported that the potential industrial uses of the bread fruit have not been sufficiently explored and investigated other than attempts aimed at determining its chemical composition. Breadfruit offers high potential in livestock nutrition containing 86.27 % dry matter, 12.98 % crude protein, 4.22 % crude fibre, 3.94 % ash and a metaboliseable energy of 3870.30 kcal/kg (for poultry) (Oladunjoye et al., 2004). Breadfruit as alternative energy feedstuffs in rabbit nutrition has not been extensively explored although Ravindran and Sivakanesan (1995), Chochelim (1987) and Udoh (1981) reported that breadfruit could be processed into meal suitable for poultry. There is presently a dearth of information on the possible utilisation of breadfruit as a source of energy in rabbit feeds. The present study, therefore, attempted to study the response of weaner rabbits fed diets containing graded levels of sun dried breadfruit replacing maize.

MATERIAL AND METHODS

Study site

The study was conducted at the Rabbit Unit of the Teaching and Research farm, College of Animal Science and Livestock Production, University of Agriculture, Abeokuta, South Western Nigeria located at latitude 7^0 N 15^l and longitude 3^0 E 21^l. The site has a sub-humid climate and an annual average rainfall of 1022 mm prevailed in the year of study.

Experimental animals

A total of 80 unsexed, mixed breed, weaner rabbits of six weeks old (weaned at 5 weeks) of weight raging from 476.05g - 486.25g obtained from the Federal College of Health and Production Technology, Ibadan, South West, Nigeria were used for the study.

Test ingredient

The ripe, breadfruits used were harvested fresh and sourced from a farm in Ile-Ife, Osun State, South West Nigeria, West Africa. The fruits were washed thoroughly so as to be free of sand, sliced into smaller chips without prior peeling using sharp knife and sun dried to a moisture content of 10-12%. The drying lasted for 5 days under intense sunshine. Care was taken such that the test ingredient was not contaminated with adherent sand. The dried samples obtained were ground to obtain the sun dried breadfruit meal (SBFM). This was mixed along with other feed ingredients in formulating the experimental diets.

Experimental management

A standard rabbit grower ration (basal diet) was formulated as a control diet using maize as the only cereal energy source. Three other dietary treatments were formulated such that ground SBFM replaced maize (weight for weight) at 22.2%, 44.4% and 66.7% levels, respectively. A total of eighty rabbits used for the study were housed individually in seperate hutch of 60 × 50 × 45cm in dimension. A rabbit was assigned to one of the four dietary treatments such that there were four dietary treatments consisting of 20 rabbits per dietary treatment. Feeder and drinker were provided in each hutch. The rabbits were fed with dietary treatments and clean water provided without restriction with the remnants removed on a daily basis. Feeders were also washed and cleaned daily. The animals were weighed on weekly basis. Experimentation procedures, care, welfare and management of the rabbits were done in accordance with the ethics of the Rabbit Management Technical Committee of the University of Agriculture, Abeokuta Nigeria

Digestibility trials

At the end of the study, 10 rabbits were chosen randomly from each treatment and moved to a metabolic cages which had been thoroughly cleaned and disinfected. Each rabbit was housed in individual metabolic cage measuring 405 × 510 × 320 mm in dimension designed to allow separate collection of feaces and urine. Rabbits contained in each treatment were fed respective dietary treatments. The rabbits were fed known weight of feed according to its daily

requirement which was increased gradually as the daily consumption increased. Records of daily feed intake and excreta collected from each rabbit were monitored for a duration of 4 days. Excreta were collected separately on a daily basis from each rabbit, weighed and oven dried at 75^0C for 48 hours. Total collection from each rabbit was pooled together and representative ground samples (10g) taken for laboratory analysis

Blood analysis

At the end of the feeding trial, 2.5 ml blood samples each were collected from 10 rabbits per treatment into separate ethylene diamine tetra acetate (EDTA) tubes, while another set was collected into heparinised tubes for serum biochemistry analysis. Haemoglobin concentration was measured in fresh EDTA anti-coagulant samples using the Sahl's (acid haematin) method (Benjamin, 1978). White blood cell (WBC) and red blood cell (RBC) counts were determined with the aid of Neubaur counting chamber (Haemocytometer). Plasma glucose was measured in fluoride oxalate anti-coagulant blood samples using the enzymatic glucose oxidase method (Bauer et al., 1974). The serum enzymes (SGPT and SGOT) were determined using commercially available diagnostic kits (Randox® Test Kits).

Carcass analysis

At the expiration of 70 days of the study, 10 rabbits whose weights are similar or close to the average weight of the treatment were chosen from each treatment and fasted 24hours before slaughter and carcass analysis. The rabbits were stunned before exsanguination using the electroshock method (320V, 50HZ) as reported by Dalle Zotte (2002). Slaughtering was done via the neck slit using a sharp stunning knife and bled for 90 seconds before flaying. The rabbits were flayed in fire to remove the fur, washed in clean water and dressed. Carcasses were prepared according to the norms of the World Rabbit Science Association (WRSA) (Blasco and Ouhayoun, 1996). Hot carcasses were suspended in a ventilated area for 30 min, and then were chilled at 4 ^{0}C until 24 h post-mortem. The head, liver, lungs, thymus, trachea, oesophagus, heart and kidneys, were then removed to obtain the ''reference'' carcass, containing only meat, fat and bone. The following traits were recorded: LW (live weight), CCW (chilled carcass weight), RCW (reference carcass weight, ie carcass without head and organs), HW (head weight), LvW (liver weight), KiW (kidneys weight), thymus, trachea, oesophagus, lung, heart and ABDFa (abdominal fat) weight. Reference carcasses were divided into technological joints as the WRSA indicated (Blasco and Ouhayoun, 1996). Joints obtained were weighed and consisted of: FLW (fore legs), TW (thoracic cage), LoW (loin) and HPW (hind part). The following were calculated: DoP, dressing out percentage (100 × CCW/LW); the weights of the following tissues as a percentages of CCW were also determined; head (Hd), liver (Lv), kidney (Kd), set of thoracic viscera (LHP), abdominal fat (ABDFa), fore legs (FLP), thoracic cage (TP) and the loin (LW).

Analytical procedures

The right hind limb was separated, the meat deboned (Blasco and Ouhayoun, 1996) while samples (10 g from each rabbit) of the meat was ground, freeze-dried, and analysed for moisture, fat, ash, energy (A.O.A.C., 1984) and cholesterol (Casiraghi et al., 1994). Samples of the ground sun dried breadfruit, experimental diets and excreta samples collected were analysed for proximate composition using the Official Methods of Association of Analytical Chemists (AOAC, 1990). Tannin and phytate content of the test ingredient were determined according to Follin Denis (AOAC, 1990) and Wheeler and Farrel (1971) methods, respectively. The fibre fraction of the SBFM was determined using the method of Goering and Van Soest (1970). The gross energy of the experimental diets, test ingredient and faecal sample were determined using the ballistic bomb calorimeter. For mineral analysis, SBFM and meat samples were ashed, while this was dissolved in hydrochloric acid, evaporated to dryness, re-dissolved in hydrochloric acid and diluted to 200 ml. Phosphorus was determined in the ash solution by measuring the yellow colour developed by the reaction, in acid medium, of phosphates with molybdate–vanadate reagent at 430 nm (AOAC, 1995). Sodium and potassium were determined in the ash solution by emission spectroscopy at 589.0 and 766.5 nm, respectively, by using an air-acetylene flame. Calcium and magnesium were measured in the ash solution by atomic absorption spectroscopy at 422.7 and 285.2 nm, respectively. For magnesium determination, a strontium chloride solution was added with the aim of avoiding chemical interferences (OJEC, 1973). Zinc and iron were determined by atomic absorption spectroscopy using single element hollow cathode lamps and air-acetylene flame.

Statistical analysis

The data obtained in this study were subjected to analysis of variance in a completely randomized design using the SAS (1991) Package. The significant differences (5% level) between mean values were determined using the Duncan's Multiple Range test (Duncan, 1955).

RESULTS

Proximate composition of sun dried bread fruit (SBFM)

The proximate composition of the SBFM (Table 1) showed an ether extract, crude protein, crude fibre, ash content of 8.40, 18.70, 5.84 and 6.0%, respectively, and gross energy content of 13.76 MJ/kg respectively. The fibre fraction showed that it contained an NDF and ADF fractions of 25.60% and 14.22%, respectively. The test ingredient also contained 0.04%, 0.20%, 2.11×10^{-6} and 6.0×10^{-3} of calcium, phosphorus, oxalate and tannin, respectively.

Growth response and nutrient digestibility of rabbits fed diets containing sun dried bread fruit (SBFM)

The growth response and nutrient digestibility of rabbits fed diets containing SBFM showed that final live weight, weight gained, feed intake, dry matter, crude protein, ether extract, ash, crude fibre and NDF digestibility were affected ($P<0.05$) by the dietary replacement of maize with SBFM inclusion (Table 2). The final live weight, weight gained, feed intake, dry matter, crude protein, ether extract and crude fibre digestibility values reduced ($P<0.05$) with increased dietary replacement of maize with SBFM inclusion. However, NDF digestibility and ash retention values increased ($P<0.05$) with increase in replacement value of maize with SBFM inclusion. Rabbits fed with 22.2% of maize replaced by SBFM recorded the highest ($P<0.05$) values for final live weight, weight gained, feed intake, dry matter, crude protein, ether extract and crude fibre digestibility, while those fed with 66.7% of maize replaced with SBFM recorded the lowest ($P<0.05$) values. The feed conversion ratio and ADF digestibility values however were not influenced ($P>0.05$) by the dietary replacement of maize with SBFM inclusion.

Table1.Gross composition of the experimental diets and sun dried bread fruit meal (SBFM).

Items	Replacement value of maize with SBFM				SBFM
	0%	22.2%	44.4%	66.70%	
Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	
Maize	45.00	35.00	25.00	15.00	
Breadfruit	0.00	10.00	20.00	30.00	
Soybean	20.00	18.00	14.00	9.00	
Wheat offal	19.00	21.00	25.00	30.00	
Fish Meal (72%)	1.00	1.50	1.00	1.50	
Palm Kernel Cake	2.50	10.00	10.00	10.00	
Bone meal	1.50	2.50	2.50	2.50	
Oyster shell	0.25	1.50	1.50	1.50	
[a]Premix	0.25	0.25	0.25	0.25	
Salt	0.25	0.25	0.25	0.25	
Total	100.00	100.00	100.00	100.00	
Determined Analysis					
Gross Energy (MJ/kg)	13.43	13.44	13.45	13.52	13.76
Crude Protein (%)	18.00	18.00	17.30	17.21	18.70
Crude fibre (%)	9.60	9.80	9.97	10.10	5.84
Ether extract (%)	4.03	4.15	4.21	4.44	8.40
Ash (%)	5.14	5.26	5.33	5.56	6.00
NDF (%)	33.21	34.33	34.51	34.87	25.60
ADF (%)	12.23	12.31	12.43	12.65	14.22
[b]Digestible energy (MJ/kg)	9.68	9.67	9.66	9.67	9.58
Ca (%)					0.04
P (%)					0.20
Oxalate (%)					2.11×10^{-6}
Tannin (%)					6.0×10^{-3}

[a]Each kg of diet contained 120 IU, Vit A, 400 g Vit E, 30 mg Vit K2, 30 mg Vit B1, 80 mg Vit B2, 60 mg Vit B6, 3 mg Vit B12, 400 mg Niacin, 120 mg Pantothenic acid, 10 mg Folic acid, 1 mg Biotin, 1 mg Antioxidant, 3000 mg Choline chloride, 800 mg Mn, 400 mg Fe, 600 mg Zn,3 mg Co, 10 mg I, and 2mg Se.
[b]Calculated value (de Blas et al., 1992) DE = GE (0.867-0.0012 ADF)
SBFM=Sun dried breadfruit

Carcass traits of rabbits fed diets containing sun dried bread fruit (SBFM).

Table 3 shows the carcass traits and bone characteristics of rabbits fed diets containing graded levels of SBFM inclusion. Chilled carcass weight, reference carcass weight and dressing out percentage decreased (P<0.05), while the weight of the gastrointestinal tract increased (P<0.05) with increased replacement of maize with SBFM. Rabbits fed with diets containing 22.2% of maize replaced with bread fruit recorded the highest values of 1330 g, 1155.50 and 81.09% g for chilled carcass weight, reference carcass weight and dressing out percentage, respectively.

Table 2. Performance and nutrient digestibility of rabbits fed graded levels of sun dried bread fruit meal (SBFM).

	Replacement value of maize with SBFM				
	0%	22.2%	44.4%	66.70%	SEM
Growth response					
Average initial weight (g)	476.25	476.05	476.25	486.25	2.52
Average final weight (g)	1550.00^{b}	1632.50^{a}	1484.25^{c}	1438.81^{d}	42.09
Average daily feed intake (g)	68.06^{b}	70.08^{a}	59.64^{c}	54.72^{d}	3.59
Average daily weight gain (g)	15.34^{b}	16.52^{a}	14.40^{c}	13.61^{c}	0.63
Feed conversion ratio	4.44	4.24	4.14	4.02	0.09
Nutrient digestibility (%)					
Dry matter	77.55^{b}	83.98^{a}	78.29^{b}	71.20^{c}	2.61
Crude protein	77.64^{b}	79.79^{a}	70.24^{c}	77.11^{b}	2.07
Ash	75.46^{b}	76.50^{b}	79.24^{a}	79.60^{a}	1.02
Ether extract	72.57^{b}	74.44^{a}	72.30^{b}	68.10^{c}	1.34
Crude fibre	63.52^{b}	66.41^{a}	62.00^{c}	57.50^{d}	0.86
NDF	51.44^{b}	51.53^{b}	52.66^{a}	53.10^{a}	0.41
ADF	42.01	42.11	42.03	41.95	0.03

^{a,b,c,d} Means on the same row having different superscripts are significantly (P<0.05) different
SBFM=Sun dried breadfruit
SEM=Standard error of mean

Table 3. Carcass yield of rabbits fed with graded levels of sun dried bread fruit meal (SBFM). SBFM=Sun dried breadfruit.

Parameters	Replacement value of maize with SBFM				
	0%	22.2%	44.4%	66.7%	SEM
Live weight (LW) (g)	1520.00^{b}	1640.00^{a}	1480.00^{c}	1450.00^{d}	41.70
Chilled carcass weight (CCW) (g)	1250.60^{b}	1330.0^{a}	1160.00^{c}	1080.0^{d}	54.27
Reference carcass weight (RCW) (g)	1060.60^{a}	1155.50^{a}	925.05^{b}	922.25^{b}	56.65
Dressing out percentage (DoP) (%)	82.27^{a}	81.09^{a}	78.38^{b}	74.40^{c}	1.75
Cut parts (% CCW)					
Trotters	2.40	1.92	2.50	1.88	0.16
Head (Hd)	10.32	10.30	9.93	9.970	0.11
GIT	15.08^{b}	15.05^{b}	16.55^{a}	16.88^{a}	0.48
Liver (Lv)	2.25	2.31	2.18	2.71	0.11
Kidney (Kd)	0.34	0.33	0.29	0.31	0.11
Heart (Ht)	0.38	0.35	0.29	0.31	0.12
Rack (Rc)	13.53^{b}	15.13^{a}	12.25^{c}	12.05^{c}	0.71
Shoulder (Sd)	8.25	7.93	7.50	8.73	0.26
Leg (Lg)	20.83	20.50	20.11	20.56	0.16
Loin (LW)	16.80	17.19	16.75	16.68	0.11

SEM=Standard error of mean
^{a,b,c,d} Means on the same row having different superscripts are significantly (P<0.05) different.

Mineral and chemical composition of hind leg cut of rabbits fed diet containing sun dried bread fruit (SBFM).

The mineral and chemical composition of hind leg cut of rabbits fed graded levels of SBFM was shown in Table 4. The P, K, Na, Mg, Ca, Zn, dry matter, protein, lipid and energy content of the rabbit meat were not affected (P>0.05) by dietary replacement of maize with SBFM inclusion. However, Fe and ash contents of rabbit meat were affected (P<0.05) by dietary replacement of maize with SBFM inclusion. Meats of rabbits fed with SBFM based diets recorded higher (P<0.05) ash and Fe contents than that of rabbits fed the control diet.

Haematological parameters and serum biochemistry of rabbits fed diet containing sun dried bread fruit (SBFM)

Table 5 showed haemoglobin (Hb) and red blood cell (RBC) values were affected (P<0.05) by the dietary SBFM inclusion Their values were reduced (P<0.05) with the increase of SBFM inclusion. Rabbits fed diets containing 66.7% SBFM recorded the highest (P<0.05) values of Hb (16.20 g/dl) and RBC (102.50×10^{12}/L), while those fed the control diet recorded the lowest (P<0.05) values (14.40 g/dl and 5.09×10^{12}/L for Hb and RBC, respectively).

Table 4. Mineral and chemical composition of hind leg meat of rabbits fed graded levels of sun dried bread fruit meal (SBFM).

Parameters	Replacement value of maize with SBFM				
	0%	22.2%	44.40%	66.7%	SEM
Mineral composition					
P (mg/100g)	225.35	225.33	225.30	225.34	0.009
K (mg/100g)	380.21	380.19	380.20	380.23	0.007
Na (mg/100g)	67.14	67.11	67.10	67.13	0.007
Mg (mg/100g)	25.01	25.00	25.04	25.02	0.007
Ca (mg/100g)	7.11	7.10	7.14	7.12	0.008
Zn (mg/100g)	10.20	10.23	10.22	10.20	0.006
Fe (mg/100g)	3.01[b]	3.73[a]	3.71[a]	3.70[a]	0.15
Chemical composition					
DM (%)	25.10	25.30	25.20	25.22	0.04
*Protein (%)	21.32	21.50	21.33	21.25	0.04
Lipid (%)	2.56	2.55	2.60	2.61	0.01
Ash (%)	1.20[b]	1.35[a]	1.37[a]	1.36[a]	0.05
Energy (MJ/kg)	6.50	6.49	6.51	6.49	0.004
Cholesterol (mg/100g)	58.29	58.28	58.27	58.29	0.004

[a,b,c,d] Means on the same row having different superscripts are significantly (P<0.05) different
SBFM=Sun dried breadfruit
SEM=Standard error of mean
*Calculated protein: 100−(water+lipids+ash).

DISCUSSION

Proximate composition of the sun dried bread fruit (SBFM)

The sun dried ground breadfruit meal (SBFM) contained higher (P<0.05) crude protein, crude fibre, ash and ether extract values than in the conventional maize. The values of the gross energy (13.76 MJ/kg) and crude protein (18.70%) recorded for SBFM in the present study indicated that it is a good source of energy and protein. However, the crude protein, crude fibre and ash values were slightly higher than the values obtained by Oladunjoye et al. (2004) who rerecorded values of 12.98 and 3.94 % for crude protein and ash contents, respectively. The gross energy recorded in this study was similar to the value recorded by Ravindra and Sivaakanesan (1995). The differences found in the proximate composition of SBFM could be due to the variety used, climatic factors, soil types and processing methods employed in processing the fruit into meal. Processing of harvested breadfruit or storage was found to alter the carbohydrate and fat levels (Nwufo and Mba, 1987; Thompson et al. 1974). The high fibre level reported for SBFM in this study could be due to the processing methods used (drying). Parkison (1984) reported that breadfruit under storage undergoes fermentation process which reduces its carbohydrate content. Ketiku (1973) reported an increased fibre content from 0.5%

to 1.1% in the unripe banana to ripe pulp. High ash content of SBFM recorded in this study agreed with the report of Ketiku (1973). The oxalate values recorded for SBFM in this study was similar to the value reported for unpeeled cooked bread fruit meal by Adekunle et al. (2006) while the tannin value recorded for SBFM in this study was higher than 2.10×10^{-6} recorded by the same author. Trace oxalate and tannin levels found in SBFM from this study were lower than values reported for maize (Ravindran et al., 1996) and were still tolerable in poultry nutrition.

Table 5. Haematology and serum metabolites of rabbits fed diets containing graded levels of sun dried bread fruit meal (SBFM).

	Replacement of maize with SBFM				
	0%	22.2%	44.4%	66.7%	SEM
Packed Cell Volume (%)	51.00	52.00	49.00	50.00	0.65
Haemoglobin (g/dl)	14.20^{b}	10.83^{c}	11.00^{c}	16.20^{a}	1.32
White Blood Cell (x10^{9}/L)	9.50	10.30	10.53	9.52	0.51
Red Blood Cell (x 10^{12}/L)	5.09^{b}	4.89^{b}	6.90^{a}	7.15^{a}	0.99
Glucose (mg/dl)	99.64	102.00	103.50	102.5	0.81
Total Protein (g/l)	49.8	52.80	52.60	50.60	0.86
SGOT (µ /l)	20.00	22.00	21.00	22.00	0.48
SGPT (µ /l)	17.60	15.00	17.00	15.00	0.68

^{a,b,c,d} Means on the same row having different superscripts are significantly (P<0.05) different
SBFM=Sun dried breadfruit
SEM=Standard error of mean

Growth response and nutrient digestibility of rabbits fed diets containing sun dried bread fruit (SBFM)

The rabbits final weight, feed intake and weight gain were influenced (P<0.05) by the dietary SBFM inclusion. Rabbits fed with diets containing 22.2% of SBFM consumed more food and gained more weight than those fed other treatments. Beyond this replacement level, weight gained reduced (P<0.05) drastically. The reduction in weight gain with increased replacement level of maize beyond 22.22% could be due to increasing powdery nature and dietary fibre level of the resultant diet as SBFM inclusion increased. Elkin et al. (1995) reported that the growth of poultry birds have been known to reduce due to the presence of antinutritional inhibitors in the diet which reduced the utilisation of energy, protein and specific amino acids. Powdery nature of SBFM could affected feed intake, digestibility, resulting in respiratory infection and consequently reduction in growth. Dry matter, ash, protein, fat and fibre digestibility reduced (P<0.05) with increased dietary replacement of maize with SBFM. The increased ash digestibility following increased dietary inclusion of SBFM is as a result of high mineral content of SBFM and this agreed with Abu (1997) who reported a significant (P<0.05) increase in the ash digestibility when rabbits were fed processed sweet potato. Rabbits fed with diets containing 22.2% maize replaced with SBFM recorded the highest value of crude protein, ether extract and fibre digestibility.

Carcass traits and bone characteristics of rabbits fed diets containing sun dried bread fruit (SBFM).

The highest (P<0.05) value of chilled carcass weight, dressing out percentage, reference carcass and rack weight reported for rabbits fed with diets containing 22.2% of maize replaced with SBFM was due to increase in growth. Lebas and Laplace (1991) already reported that variation in nutritional status and requirement of growing rabbits modify the anatomical equilibrium of the carcass, composition of carcass tissues and components of the muscle. Weight of cuts have been of major interests to poultry consumers (Skinner et al., 1992). Fanimo et al. (2003) reported that the shoulder, rack and loin are the most economically important portions of the carcass because they provide the greatest potions of edible meat for consumers. Lower values of rack weight were recorded in rabbits fed diets containing 44.4% and 66.7% maize replaced with SBFM while the highest (P<0.05) value was recorded in rabbit fed with diets containing 22.2% maize replaced with SBFM.

Mineral and chemical composition of hind leg meat of rabbits fed diet containing sun dried bread fruit (SBFM).

The higher values of Fe and ash content reported in this study for hind meat of rabbits fed diets containing SBFM could be due to the high ash values of SBFM. However, it should be noted that mineral profile of rabbit meat is a function of cuts, age of the animals and various other factors. Hind legs were chosen in this study to ensure uniformity. The phosphorus, sodium and magnesium content of rabbit meat recorded in this study was similar to the values reported in the literature for P (224–230 mg/100 g) (Combes, 2004; Niinivaara and Antila, 1973), sodium (Moreiras et al., 2004) and magnesium (Niinivaara and Antila 1973; Combes, 2004 and Moreiras et al., 2004). The levels of iron reported in rabbit meat in this study were lower than those recorded in previous studies (10–15 mg/ kg; Combes, 2004; Falandysz, 1991;

Falandysz et al., 1994), but similar to values reported by Lucker et al. (1998) for rabbit meat sampled from the back leg muscle. The iron content in meat varies significantly between the different meat cuts (Lombardi-Boccia et al., 2005; Lucker et al., 1998). However higher iron values recorded in hind meat of rabbits fed with graded levels of SBFM based diets could be related to the high ash content of sun dried breadfruit.

Haematological parameters and serum biochemistry of rabbits fed diet containing sun dried bread fruit (SBFM)

Increase in haemoglobin (Hb) and red blood cell (RBC) values observed with increased SBFM inclusion implied that the protein quality of the resultant diets were not compromised as a result of increased dietary inclusion of sun dried bread fruit meal. Pellet and Young (1980) showed that erythrocytes and haemoglobin were positively correlated with protein quality and protein level of the diet. Church and Pond (1982) also reported that ingestion of numerous dietary components have measurable effects on blood constituents. Hence, examination of blood provides a valuable opportunity to clinically evaluate the quality of feed. Increased haemoglobin values following SBFM inclusion and replacement of maize could be linked with increased iron content of the blood which is also related to higher ($P<0.05$) iron values recorded in hind meat of rabbits fed with graded levels of SBFM. However, further research is needed to validate this findings.

CONCLUSIONS

Breadfruit offers high potential as feed ingredient in rabbit nutrition due to its high protein and energy value and could therefore be used as alternative energy feedstuffs in place of maize in rabbit feeds. The findings of this work indicated that sun dried bread fruit (SBFM) could be used successfully to replace 22.2% maize in a rabbit diet with optimum growth response, carcass yield and nutrient digestibility. Beyond this inclusion, carcass yield and nutrient digestibility are compromised.

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Submitted July 29, 2009 – Accepted August 28, 2009
Revised received September 17, 2009