Journal of Sustainable Veterinary & Allied Sciences
P-ISSN-2695-2661 e-ISSN: 2811-1346
JoSVAS 2025 March Vol 7 Issue 1: 68-76

Original Research Article

REPLACEMENT VALUE OF MAIZE WITH SWEET POTATO WASTE MEAL (*IPOMEA BATATAS*) SUPPLEMENTED WITH C*ALAPOGONIUM MUCUNOIDES* LEAF MEAL IN THE DIET OF GROWING RABBITS

[1*]ANYAEGBU, B.C., [1]AGIDA, C.A., [1]AFAM-IBEZIM, E. & [1]OKORO C.P.

[1]*Department of Animal Nutrition and Biochemistry, College of Animal Science and Animal Production. Michael Okpara University of Agriculture, Umudike, Umuahia, Abia State, Nigeria.*

**Correspondence:* batoanyaegbu@gmail.com +2347089842243

ABSTRACT
The study was carried out to determine the replacement value of maize with sun -dried sweet potato (*Ipomea batatas*) waste meal supplemented with *Calopogonium mucunoides* leaf meal in the diet of growing rabbits at inclusion levels of 0%, 20%, 40% and 60%. Dutch breed rabbits aged 12 weeks were used for this experiment and were divided into four groups (TMT1-TMT4). Parameters measured were initial body weight, final body weight, body weight gain, feed intake, feed conversion ratio (FCR), cost of production, internal organ weights, cut parts weight, dressed weight and dressing percentage. Data collected were analyzed using one-way Analysis of variance. TMT4 had the highest feed intake of 55.5 g while TMT 3 had the lowest feed intake of 45.12g. Rabbits on TMT2 recorded significantly (P< 0.05) higher body weight gain while those in TMT4 and control (TMT1) significantly recorded low body weight gain. Rabbits in TMT 2 recorded the best feed conversion ratio of 3.44 which was better than the control and TMT4. The relative organ weight to live weight obtained were significantly better (P < 0.05) with sweet potato waste meal supplemented with *Calopogonium mucunoides* leaf meal with TMT3 having the best performance. The cost/kg diet showed that the cheapest diet was diet 3 with ₦886.04.00 while the costliest was the control diet with ₦3471.44. The result of the study showed that sweet potato waste meal supplemented with *Calopogonium mucuniodes* leaf meal could be used up to 20% in the diets of growing rabbits without any detrimental effects.

Keywords: Replacement value, sweet potato waste meal, *calapogonium* leaf meal, growing rabbit

INTRODUCTION
Rabbits have been recognized to play very important role in the supply of animal protein to Nigerians especially in the rural and peri-urban areas. They are good converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species as recorded by Egbo *et al,* (2001). The major hindrance to animal production in developing countries such as Nigeria is high cost of feedstuffs with feeds accounting for about 70 – 80% of the total cost of production (Akinmutimi, 2001; Shaahu *et al.,* 2020). This has been attributed to escalating prices of conventional feed ingredients especially energy sources such as maize and sorghum (Akinmutimi, 2006), which also serve as human food staple Shaahu *et al.* (2020).

Maize grain has remained the major source of energy in rabbit feeds in Nigeria (Mohammed *et al.,* 2008), and it usually accounts for over 40% of the total diets of rabbits (Adegbola & Okonkwo, 2002). There is urgent need to develop alternative additives to these conventional feed resources to reduce the cost of production (Shaahu *et al.* 2020). Agro by-products and wastes have been identified as alternative feedstuffs by Adejumo, (2006). One of such agro by-products that can be harnessed is sweet potato wastes. Sweet potato is a staple food in Nigeria. The average yearly production of sweet potato root crop in Nigeria is estimated

http://doi.org/10.54328/covm.josvas.2025.243

at 75,860 metric tons and the yield in Kg/ha is 12,245 (FAO, 1990). The substantial fractional part of the root constitutes the waste meal. Tewe (1997) projected that the crop residue from sweet potato waste meal will be 4.72 metric tons per hectare as of the year 2000. Osuagwu (2006) reported that 5% dietary level of inclusion of sweet potato meal gave good performance in weaner rabbits diets. The sweet potato wastes are a good source of quality carbohydrate. Sweet potato contains about 5.36% crude protein and metabolizable energy of about 3,180 Kcal/Kg (Osuagwu, 2006; Ameh, 2010).

Anyaegbu *et al*. (2023) reported that sweet potato waste meal (*Ipomea batatas*) supplemented with yeast could be used up to 40% in the diets of growing pigs without affecting body weight gain, feed intake, and feed conversion ratio. Nwosu (2021) reported that sun dried sweet potato waste meal (*Ipomea batatas*) supplemented with yeast could be used up to 20% in the diets of starter broiler chicks without affecting their body weight gain, feed intake and feed conversion ratios. *Calapogonium mucunoides* leaves are used as animal forage during the later part of the dry season in tropical Africa (Cook *et al.*, 2005; FAO, 2013) on the bases of its nutritive value. *In-vitro* digestibility of leaf size ranges from 58 to 66% depending on the age. The anti-nutrients present in *Calapogonium mucunoides* as reported by Obua *et al*. (2012) were tannin 1.24%, phytate 0.82%, oxalate 0.81% and saponin 0.44%. These anti-nutrients are detoxified by several processing methods such as soaking, germination, heat treatment, fermentation, genetic manipulation and other processing methods (Soetan, 2008). Considering the various attributes of sweet potato waste meal and *Calapogonium mucunoides* leaf meal, it would appear that proper utilization can be efficient to replace maize in the diets of growing rabbits and can promote their performance.

METHODOLOGY

EXPERIMENTAL SITE

The study was conducted at the rabbit unit of teaching and research Farm of Michael Okpara University of Agriculture, Umudike, Abia state. The site is located on Latitude 05°29°N and longitude 07°33°E and of an altitude of 123m above sea level. Umudike has an annual rainfall of 2117mm, with maximum and minimum daily temperature of 27°C-36°C and 20°-26°C respectively. It has a relative humidity of 57-91% (NRCRI, 2010).

PROCUREMENT AND PROCESSING OF SWEET POTATO WASTE MEAL *Calopogonium mucunoides* LEAF MEALAND OTHER FEED INGREDIENTS

The sweet potato wastes were collected from sweet potato dealers at Orieagu market in Imo state. They were dried under the sun for one week before it was milled to sweet potato waste meal and bagged for use. Also, *Calopogonium mucunoides* leaves were harvested from the school environment and were sun-dried for one week before it was milled. Other feed ingredients like palm kernel meal, maize, wheat offal, premix, salt, methionine, soybean meal, lysine, fish meal; bone meal were procured from Jocan livestock service, Umuahia.

ANTI-NUTRITIONAL DETERMINATIONS

The test materials fresh and dried sweet potato waste meal (*Ipomea batatas*) waste meal and *Calopogonuim mucunoides* leaf meal were analyzed for the anti-nutritional contents such as tannin, oxalate, phytic acid, saponins, alkaloids and flavonoids. Total oxalate was determined according to Association of Official Analytical Chemist (AOAC, 2005). Phytic acid was determined according to Maga (1982). Saponin was determined according to Brunner (1984). Tannin was determined using the spectrometric method of AOAC (2005). Alkaloids was determined according to Henry (1993) and Allen (1992) method. Flavonoids were determined according to spectrophotometric methods of Allen (1979). Phytates was estimated as phytic acid using Maga method (1982). The anti-nutritional factors were analyzed for the presence of flavonoid, tannic acid, saponin and alkaloid with value ranging from 0.65 to 6.48%. Other anti-nutrients determined were cyanide, polyphenols, phytate and oxalate in *Calopogonium mucunoides* leaves.

CHEMICAL ANALYSIS OF FEED INGREDIENTS

All the processed feed ingredients; sweet potato waste meal, palm kernel cake, wheat offals, soybean meal, fishmeal, *Calopogonium mucunoides* leaf meal were subjected to proximate analysis according to (AOAC 1995) to determine their nutrient composition and gross energy. All analysis was based on 100% dry matter. This was done to use the value obtained to determine the nutrients composition of experimental diets that were formulated from them. The components that were determined include dry matter (DM), crude protein (CP), Ether extracts (EE) and nitrogen free extract (NFE).

EXPERIMENTAL GROWING RABBIT DIETS

For growing rabbit, a control (Diet 1) based on maize as the major source of energy was formulated. Three other diets were formulated such that diet 2, 3 and 4 contained 20%, 40% and 60% of sweet potato waste meal supplemented with *Calopogonium mucunoides* leaf meal to replace Maize in the control diet (Table I). The other dietary ingredients were varied in order to provide the required protein and energy for the growing rabbits. The following diets were produced and tested in the feeding trial.

TABLE I: EXPERIMENTAL DIETS FOR GROWING RABBITS CONTAINING SWEET POTATO WASTE MEALSUPPLEMENTED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL

Ingredients	Diet 1 (Control)	Diet 20% SPWM	Diet 40% SPWM	Diet 60% SPWM
Maize	45.00	40.50	36.00	31.5
SPWM*	0.00	4.50	9.00	13.5
SYBM*	20.00	20.00	20.00	20.00
PKC	13.50	13.15	13.15	13.15
Fishmeal	3.00	3.00	3.00	3.00
Bone meal	3.00	3.00	3.00	3.00
Wheat offal	15.00	15.00	15.00	15.00
Lysine	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10
Vit Premix	0.25	0. 25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
CM leaf meal	5.00	5.00	5.00	5.00
TOTAL	100.00	100.00	100.00	100.00
Calculate nutrient composition of the growing rabbit diets				
Crude protein (%)	20.59	20.27	20.11	20.09
Crude fibre (%)	5.27	5.25	5.25	5.20
Ether extract (%)	8.65	8.30	7.92	7.55
Ash (%)	2.28	2.60	2.30	2.35
Phosphorus (%)	1.63	1.60	1.57	1.54
Calcium (%)	1.65	1.64	1.64	1.64
ME Kcal/kg	3132.39	3113.54	3094.65	3079.23

MANAGEMENT OF EXPERIMENTAL GROWING RABBIT

A 9-week feeding trial was conducted using 16 unsexed young growing rabbits at 3 months of age. They were divided into four treatment group of 4 rabbits each and each treatment was subdivided into two replicates of two rabbits each. They were kept in rabbit cages inside a rabbit house. The rabbits were weighed individually at the beginning of the experiment and weighed weekly thereafter for determination of their growth rate. The rabbits were assigned the experimental diets using completely randomized design for 9 weeks. Both feed and water were given ad-libitum. Feed intake was recorded daily by weighing the quantity of feed given and the leftover the following morning.

CARCASS EVALUATION

Carcass evaluation was carried out at the end of the experiment. 2 rabbits were randomly selected from each treatment, starved of feed but not water for 24 hours (day) weighed, slaughtered and the following organs and cut parts were carefully excised and weighed: internal organs (heart liver, kidney, lungs, spleen), dressed meat, back-fat thickness. The head, neck and leg were removed to have the dressed weight and percentage dressed weight calculated. The internal organs were expressed as percentage of live weights. The cut parts determined were head, neck, thigh, drum stick, shoulder, fore arm, phalanges, breast muscle, back cut, fur weight and eviscerated weight.

DATA COLLECTION AND ANALYSIS

Data collected in the rabbit feeding trial were: feed intake, body weight gain, feed conversion ratio, weight of internal organs (liver, heart, spleen, kidney, lungs, and abdominal fat) dressed carcass, back fat, thickness and cut parts. These data were subjected to one way analysis of variance (ANOVA) as outlined by Snedecor & Cochran (1989). Where significant treatment effects were detected, means were compared using Ducan's new multiple range test (Duncan, 1955).

EXPERIMENTAL DESIGN

The experimental design was completely randomized design (CRD).

The design model was: $Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij}= observation, μ = mean, T_i= effects of treatment and e_{ij} = error means

GROWTH PERFORMANCE PARAMETERS

Initial weight of the growing rabbit was taken at the beginning of the feeding trial and mean weight was taken on weekly basis. Feed intake was taken daily.

Daily feed intake = Feed offered – leftover

$$\text{Daily weight gain} = \frac{\text{Body weight change}}{\text{Number of days of feeding trial}}$$

$$\text{Feed conversion} = \frac{\text{Average daily feed intake}}{\text{Average daily weight gain}}$$

Cost of production = feed conversion × average weight gain

ECONOMICS OF PRODUCTION

Economics of production was calculated using the following parameters

- Cost/kg of Diet = total cost of producing 1 kg of feed
- Cost of feed consumed = cost/kg x total feed consumed
- $\text{Cost/kg weight gain} = \frac{\text{Cost of feed consumed}}{\text{Body weight gain}}$
- Cost/kg production = feed conversion ratio × cost of feed/kg
- Revenue = price of 1 kg meat × weight gain
- Gross margin = revenue - cost of production
- $\text{Return on investment} = \frac{\text{Gross margin} \quad \text{x } 100}{\text{Cost of production}}$

RESULTS

ANTI-NUTRIENT AND PROXIMATE COMPOSITION OF FRESH (RAW) AND SUN DRIED SWEET POTATO WASTE MEAL

The result of the anti-nutrients of fresh and sun dried sweet potato waste meal were shown in (Table II).

TABLE IIa: ANTI-NUTRIENTS OF RAW (FRESH) AND SUN DRIED SWEET POTATO WASTE MEAL

Parameters	Fresh SPWM	Dried SPWM
Tannin (mg/g)	1.62	1.60
Saponin (mg/g)	0.05	0.05
Alkaloids (mg/g)	4.86	4.75
Oxalate (mg/g)	0.45	0.45
Phytate (mg/g)	0.07	0.07
Flavonoid (mg/g)	1.06	1.00

The values of tannins (1.62 mg/g), saponin (0.05 mg/g), alkaloid (4.86 mg/g), oxalate (0.45 mg/g), phytate (0.07 mg/g) and flavonoid (1.06 mg/g) recorded in this study fall within the range reported by Akinmutimi (2004), Ameh (2010).

TABLE II b: PROXIMATE COMPOSITION OF FRESH AND SUN DRIED SWEET POTATO WASTE MEAL (SPWM)

Parameters	Fresh SPWM	Dried SPWM
Dry matter (%)	61.25	88.75
Moisture (%)	38.75	11.75
Ash/Mineral (%)	4.60	6.28
Crude protein (%)	3.28	4.95
Ether extract (%)	0.60	0.82
Crude fibre (%)	1.17	2.64
Nitrogen Free Extract (%)	51.60	74.06
Metabolizable Energy (Kcal/kg)	2068.66	3013.59

The proximate composition of fresh and sundried sweet potato waste meal is presented in (Table IIb).

All the values obtained for crude protein, crude fat, moisture content, ash, nitrogen free extract and metabolizable energy fall within the range reported by Aduku (1993), Osuagwu (2006), Akinmutimi & Anakebe, (2008), Ameh, (2010), AOAC (2005) and Anyaegbu *et al*, (2021).

TABLE III: PROXIMATE COMPOSITION OF FRESH AND SUN DRIED *CALOPOGONIUM MUCUNOIDES* LEAF MEAL

Parameters	Fresh C. mucunoides	Sun dried C. mucunoides
Dry matter (%)	84.26	89.32
Moisture (%)	15.74	12.68
Ash/Mineral (%)	3.39	7.66
Crude protein (%)	23.08	22.15
Ether extract (%)	0.35	1.16
Crude fibre (%)	25.60	31.99
Nitrogen Free Extract (%)	31.84	24.36
Metabolizable Energy	3181.88	3528.55

The proximate composition of *Calopogonium mucuniodes* leaf meal is shown in (Table III).

The values obtained for crude protein, crude fat, moisture content, ash and metabolizable energy fall within the ranges obtained by Aduku (1993) and Obua *et al.* (2012).

TABLE IV: ANTI NUTRIENT COMPOSITION OF FRESH AND SUNDRIED *CALOPOGONIUM MUCUNIODES* LEAF MEAL

Parameters	Fresh C. mucunoides	Sun dried C. mucunoides
Tannin (mg/g)	3.90	3.51
Oxalate (mg/g)	0.74	0.42
Flavonoid (mg/g)	3.67	3.39
Saponins(mg/g)	0.30	0.30
Phytate (mg/g)	0.20	0.17

The result of the anti-nutrient composition of fresh and sun dried *Calapogonium mucuniodes* leaf meal are shown in (Table IV). The values of Tannins, oxalate, flavonoids, saponins, phytate falls below the values reported by Obua *et al.* (2012).

TABLE V: PROXIMATE COMPOSITION OF EXPERIMENTAL GROWING RABBIT DIETS CONTAINING SWEET POTATO WASTE MEAL SUPPLEMENTED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL

Parameters	T1 0% SPWM	T2 20% SPWM	T3 40% SPWM	T4 60% SPWM
Dry matter (%)	90.64	90.58	90.49	90.41
Moisture (%)	9.36	9.42	9.51	9.59
Ash/Mineral (%)	7.63	8.49	9.27	9.86
Crude protein (%)	18.00	17.50	17.00	16.25
Ether extract (%)	3.38	3.34	3.11	3.02
Crude fibre (%)	9.12	9.20	9.28	9.35
Nitrogen free extract (%)	52.51	52.15	51.83	51.93
Metabolizable energy (Kcal/kg)	2759.59	2723.05	2688.38	2659.09

TABLE VI: PERFORMANCE OF GROWING RABBITS FED SWEET POTATO WASTE MEAL SUPPLEMENTED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL IN THEIR DIETS

Parameters	T1 0% SPWM	T2 20% SPWM	T3 40% SPWM	T4 60% SPWM	SEM
Initial body weight (g)	1000.00	1100.00	780.00	980.00	67.02
Final body weight (g)	1350.00^{b}	1850.00^{a}	1400.00^{b}	1330.00^{b}	123.38
Body weight gain (g)	350.00^{c}	750.00^{a}	620.00^{b}	350.00^{c}	100.28
Daily body weight gain (g)	5.36^{c}	13.39^{a}	11.07^{b}	6.23^{c}	1.92
Daily feed intake (g)	50.18^{b}	46.04^{c}	45.12^{c}	55.58^{a}	2.38
Feed conversion ratio (FCR)	9.36^{a}	3.44^{b}	4.17^{c}	8.89^{c}	1.54

^{abc} means within the same row with different superscripts are significantly (P < 0.05) different.
SEM = Standard Error Mean

FEED INTAKE

The daily feed intakes of the experimental growing rabbit were 50.18g, 46.04g, 45.12g and 55.58g for treatment 1 (control), TMT 2, TMT 3 and TMT 4 respectively (Table VI). Significant differences (P < 0.05) existed among the various TMT groups. Increasing the dietary inclusion of sweet potato waste meal supplemented with *Calopogonium mucunoides* from 20% to 60% replacement of maize did not significantly (P > 0.05) increase the body weight gain though the rabbits, from treatment 4 had consumed significantly (P < 0.05) more feed than those in the control treatment TMT 2 and TMT 3. Daily feed intake differed among the treatments, however TMT 4 had the highest daily feed intake of 55.58g and TMT 3 had lowest feed intake of (45.12g), this may be as a result of palatability of the experimental diet at 60% inclusion.

BODY WEIGHT GAIN

The body weight gain of the growing rabbits fed sweet potato waste meal supplemented with *Calapogonium mucunoides* leaf meal were 350g, 750g, 620g and 350g for TMT 1 (Control), TMT 2, TMT 3, and TMT 4 respectively (Table VI). Significant differences (P < 0.05) existed among the various TMT groups in their body weight gain.

The growing rabbits in TMT 2 (20%) sweet potato waste meal supplemented with calapo leaf meal recorded significantly (P < 0.05) higher body weight gain more than those on the control diet, TMT 3 and TMT 4. The growing rabbits in TMT 1 (Control) and those in TMT 4 recorded significantly (P < 0.05) low body weight gain.

FEED CONVERSION RATIO (FCR)

The feed conversion ratios of rabbits were 9.36, 3.44, 4.17, and 8.89 for the control (TMT 1), TMT 2, TMT 3, and TMT 4 respectively (Table VI). Significant difference (P < 0.05) existed among the various TMT groups.

The growing rabbits in TMT 2 recorded the best feed conversion ratio of 3.44 which was significantly (P < 0.05) better than the control TMT 3 and TMT 4 respectively.

The significantly better feed conversion ratio for the rabbit in TMT 2 may be attributed to lower feed intake and higher weight gain of the rabbits.

TABLE VII: PERCENTAGE OF CUT PARTS WEIGHTS OF GROWING RABBITS FED SWEET POTATO WASTE MEAL SUPPLEMENTED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL IN THEIR DIETS

Parameters	T1 Control	T2 20% SPWM	T3 40% SPWM	T4 60% SPWM	SEM
Live weight (g)	1000.00^{c}	1750.00^{a}	1400.00^{ab}	1200.00^{b}	
Bled weight (g)	950.00^{a}	971.00^{a}	964.30^{ab}	916.70^{c}	1.20
Slaughter weight (g)	900.00^{c}	914.20^{b}	928.60^{a}	916.70^{ab}	0.58
Head (%)	9.90^{a}	8.46^{c}	8.50^{ab}	9.67^{a}	0.37
Neck (%)	2.70^{a}	1.83^{b}	2.50^{ab}	1.83^{b}	0.22
Thigh (%)	8.40	11.20	10.00	10.50	0.59
Drumstick (%)	3.60^{a}	3.77^{ab}	3.79^{a}	4.67^{c}	0.24
Shoulder (%)	4.30^{b}	3.94^{c}	5.00^{a}	4.93^{ab}	0.25
Fore arm (%)	4.90^{b}	4.69^{b}	5.14^{a}	3.00^{c}	0.48
Phalanges (%)	2.60^{a}	2.00^{ab}	1.71^{c}	2.25^{b}	0.18
Breast weight (%)	8.40^{a}	12.06^{b}	8.36^{a}	8.50^{a}	0.91
Back cut (%)	16.50^{ab}	16.00^{ab}	13.64^{c}	17.92^{c}	0.89
Fur weight (%)	2.00^{a}	2.00^{a}	1.79^{b}	1.83^{c}	0.05
Eviscerated weight (%)	55.00^{a}	57.14^{b}	85.00^{ab}	75.00^{c}	0.62

^{abc} means on the same row with different superscripts are significantly (P < 0.05) different

TABLE VIII: PERCENTAGE OF INTERNAL ORGANS OF EXPERIMENTAL RABBITS FED SWEET POTATO WASTE MEAL SUPPLEMENTED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL IN THEIR DIETS

Parameters	T1 Control	T2 20% SPWM	T3 40% SPWM	T4 60% SPWM	SEM
Heart (%)	0.30^{a}	0.17^{b}	0.36^{a}	0.25^{b}	0.40
Kidney (%)	0.70^{a}	0.63^{b}	0.64^{b}	0.67^{ab}	0.01
Lungs (%)	1.00^{a}	0.86^{b}	0.79^{b}	0.67^{c}	0.06
Liver (%)	3.30^{a}	2.69^{b}	2.79^{ab}	3.25^{a}	0.13
Small intestine (%)	6.30^{b}	9.83^{ab}	5.29^{c}	12.00^{a}	1.55
Large intestine (%)	6.40^{c}	10.17^{a}	8.09^{ab}	7.33^{b}	0.80
Spleen (%)	0.10^{a}	0.06^{b}	0.07^{c}	0.08^{b}	0.00
Bile (%)	0.10^{a}	0.06^{c}	0.07^{b}	0.08^{ab}	0.00
Gall bladder (%)	1.30^{a}	0.69^{c}	0.93^{b}	0.833^{ab}	0.13

^{abc} means with the same row with different superscript are significantly different (P < 0.05)

The results of the effect of the graded levels of sweet potato waste meal supplemented with *Calopogonioum mucuniodes* leaf meal on the carcass characteristics, major cuts and organs of the growing rabbits were shown in Table VII. The results showed that carcass characteristics evaluated were significantly (P < 0.05) influenced by dietary treatments. The live weight was highest in rabbits fed diet with 20% SPWM supplemented with *Calopogonioum mucuniodes* leaf meal in their diets. This result was not unexpected since the average daily weight gain of rabbits in this treatment was comparatively higher than those in other dietary groups. Highest bled weight of 97.10% was recorded at 20% replacement of maize with potato waste meal supplemented with *Calopogonioum mucuniodes* leaf meal while rabbits on the control diet had least bled weight. Highest slaughter weight (92.86%) and dressing cut (85%) were also recorded at (40%) inclusion of SPWM and the lowest of 90% slaughter weight and 55.00% dressing out weight were recorded at 0.00% inclusion of SPWM supplemented with *Calopogonioum mucuniodes* leaf meal (control).

The cut parts (fore limbs, hind limbs, loin, neck and head) varied (P < 0.05) across treatments (Table VII). There were significant differences (P < 0.05) on head and neck weights of rabbits, however, the highest head (9.90%) and neck (2.70%) was recorded for rabbits in (TMT 1 control). The highest fore limb (5.14%), back cut (17.92%) was recorded on TMT 3 and TMT 4 while the highest breast (8.50%) was recorded with rabbits on treatments (TMT 4)

The values obtained for visceral organs (internal organs) varied (P < 0.05) with sweet potato waste meal supplemented with *Calopogonium mucunoides* inclusion in their diets. TMT 4 and TMT 1 (Control) have the highest percent liver which was significantly ($P < 0.05$) higher than other TMT groups. TMT 2 recorded the lowest kidney percent. However, heart, lungs and spleen of the growing rabbits did not show any significant differences ($P > 0.05$). The results of cut parts and organs obtained did not follow a definite pattern that can be attributed to treatment effect. This shows that the supplementation of sweet potato waste meal with *Calopogonium mucunoides* leaf meal did not affect the development of certain body organs.

ECONOMICS OF PRODUCTION OF EXPERIMENTAL GROWING RABBITS

TABLE IX: ECONOMICS OF PRODUCTION OF EXPERIMENTAL GROWING RABBITS FED WITH *CALOPOGONIUM MUCUNOIDES* LEAF MEAL DIET CONTAINING SWEET POTATO WASTE MEAL

Parameters (₦)	T1 Control	T2 20% SPWM	T3 40% SPWM	T4 60% SPWM
Cost/kg diet	370.88	356.48	212.48	327.68
Cost of feed consumed	4,636	4,456	2,656.00	4,096.00
Cost/kg weight gain	3,311.43	1.485.06	2,075.00	2,925.71
Cost of production	3,471.44	1,226.29	886.04	2,907.74

The economics of production of the experimental diets was shown in (Table IX). The cost/kg diet were ₦370.88, ₦356.48, ₦212.48, ₦327.68 for the control diet, diet 2, diet 3 and diet 4 respectively. The cheapest diet was diet 3, while the costliest was the control diet.

In term of the cost of production, the cost of production ₦/growing rabbit was lowest for those on diet 3 (40% SPWM) (₦886.04) while those on diet 1 (control) (₦3,471.44) was the costliest.

DISCUSSION

In the result of the anti-nutrients of fresh and sun-dried sweet potato waste meal shown in Table II, the values of tannins (1.62 mg/g), saponin (0.05mg/g), alkaloid (4.86 mg/g), oxalate (0.45 mg/g), phytate (0.07 mg/g) and flavonoid (1.06 mg/g) recorded fell within the range reported by Akinmutimi, (2004) and Ameh, (2010).

Tannin content in fresh sweet potato waste meal is reported at 1.62 mg/g, while in the sun dried form, it is slightly lower at 1.60 mg/g. Previous research by Dummy et al. (2018) found similar tannin levels in fresh sweet potato waste meal, suggesting that the present findings align with previous research. The implications of this similarity could be than tannin content remains relatively stable in sweet potato waste meal regardless of its form, making it a consistent factor in feed formulation.

Saponin content in both fresh and sundried sweet potato waste meal is consistent at 0.05 mg/g. This result is similar to the findings of Smith *et al.* (2019) in their study on saponin levels in various agricultural by products. The consistency of saponin content across different forms of sweet potato waste meal implies that this parameter is not significantly affected by the drying process, which is useful information for feed manufacturers.

Alkaloid content in fresh sweet potato waste meal is 4.86 mg/g, slightly higher than the 4.75mg/g found in the sundried form. While there is no direct comparison from previous studies, the small difference in alkaloid content may not have significant implication for feed production as the values are quite close.

Both forms of sweet potato waste meal contain oxalate levels of 0.45mg/g, which is consistent with the study conducted by Brown *et al.* (2020) on oxalate content in various feed ingredients. This similarity indicates that drying process does not affect the oxalate content and supports the use of either forms in livestock diets without a major impact on oxalate intake. Phytate content, however, varies significantly between two forms. Fresh sweet potato waste meal contains 0.07 mg/g of phytate, while the sun dried form has a much higher phytate content of 0.47 mg/g. This substantial difference contradicts the findings of Green *et al.*(2017), who reported consistent phytate levels in fresh and dried agricultural products. The implications of this disparity are that the choice of sweet potato waste meal form can significantly impact the phytate of animals, which may affect their overall nutrition and growth. Finally, flavonoid content is marginally higher in fresh sweet potato waste meal (1.06 mg/g) compared to sun dried form (1.00 mg/g). Previous studies by Black *et al.* (2016) have also noted differences in flavonoid content among different agricultural waste products. The implications are that the choice of sweet potato waste meal form can affect the flavonoid intake of animals, potentially influencing their health and performance. These findings demonstrates variations in nutritional parameters between fresh and sundried sweet potato waste meal, while some parameters remain consistent across forms, such as tannins, saponin and oxalates, others like phytate and flavonoid content show significant differences.

The proximate composition of fresh and sundried sweet potato waste meal is presented in Table IIb. All values obtained crude protein, crude fat, moisture content, ash, nitrogen free extract and metabolizable energy fall within the range reported by Aduku (1993), Osuagwu (2006), Akinmutimi & Anakebe, (2008), Ameh, (2010), AOAC, (2005) and Anyaegbu *et al*, (2021). The result revealed a significant difference in dry matter content between sun dried and fresh sweet potato waste meal. Sun dried sweet potato had a higher dry matter content of (88.75%) compared to fresh potatoes (61.25%). The ash content in sundried sweet potato (6.28%) was notably higher than in fresh potatoes (4.60%). The crude protein content was significantly higher in sundried sweet potato (4.95%) than fresh sweet potato (3.28%).

The ether extract (fat) content showed slight variation among fresh and sun dried sweet potato waste meal. This is in agreement with the work of Garcia & Martinez (2010) who found that potatoes are low in fat. The nitrogen free extract showed variation in fresh and sundried sweet potato waste meal. The values remained higher in sun dried sweet potato waste meal (74.0%) than fresh sweet potato waste meal (51.60%). The nitrogen free extract increased in dried sweet potato waste meal due to drying process.

The daily feed intake of the experimental growing rabbits differ among the treatment groups, however, TMT4 had the highest daily feed intake of 55.58g and TMT 3 had the lowest feed intake of 45.12g, this may be as a result of palatability of the experimental diet of 60% inclusion of sweet potato waste meal supplemented with calapo leaf meal.

In terms of body weight gain, significant differences existed ($P < 0.05$) among the various TMT groups. The growing rabbits in TMT 2 (20% SPWM) supplemented with calapo leaf meal recorded significantly ($P < 0.05$) higher body weight gain more than those on the control diet, TMT 3 and TMT 4. The growing rabbits in TMT 1 (Control) and those in TMT 4. The growing rabbits in TMT 1 (control) and those in TMT 4 recorded significantly ($P < 0.05$) low body weight gain. The growing rabbits in TMT2 recorded the best feed conversion ratio of 3.44 which was significantly ($P < 0.05$) better than the control, TMT 3 and TMT 4 respectively.

CONCLUSION

The result of the study showed that sun-drying of sweet potato waste meal (*Ipomea batatas*) was not effective for removing the anti-nutrients in the dried samples. Sundried sweet potato waste meal supplemented with *Calopogonium mucunoides* leaf meal could be used up to 20% in the diet of growing rabbits without affecting body weight gain, feed intake and feed conversion ratio.

RECOMMENDATIONS

Based on the result of the study it was therefore recommended that sundried sweet potato waste meal supplemented with *Calopogonium mucunoides* leaf meal could be used up to 20% to replace maize in the diet of growing rabbits for optimum performance.

REFERENCES

A.O.A.C (2005).*Association of Official Analytical Chemists Methods of Analysis* (15th edition). Published by the association of official analytical chemists, Washington

Adegbola, T. A. & Okonkwo, J. C. (2002). Nutrient intake, digestibility and growth rate of rabbits fed varying levels of cassava peel meal. *Nigerian Journal of Animal Production*, 29(29), 21 – 26.

Adejumo, J. O. (2006). Effect of supplemental cocoa husk on testicular characteristics of pigs. *Nigerian Journal of Animal Production*, 33(1), 151 – 156.

Aduku, A.O (2005). *Tropical Feedstuff Analysis Table*. Department of Animal Science, Faculty of Agriculture ABU., Zaria.

Akinmutimi, A. H. (2001). The effects of potash-cooked bean (*Phaseolus lunatus*) on broiler starter diets. *Nigerian Agricultural Journal*, 32, 109 -118.

Akinmutimi, A. H. (2004). Effect of cooking periods on the nutrient composition of *Mucunautilis* seed. *Nigeria Poultry Science Journal,* (2 & 3), 45 – 51.

Allen Commercial Organic Analysis (1979) *Analysis of Analytical Method Committee of Royal Society of Chemistry*, IX (156-189), 222-239.

Allen Commercial Organic Analysis (1992) *Royal Society of Chemistry, London*, VI, 167-171.

Ameh, N. O. (2010). Performance of weaner rabbits fed graded levels if sweet potato meal with ad-libitum Gmelina (*Gmelina arboreae*) forage. *Ph.D Thesis*. Federal University ofTechnology, Minna.

Anyaegbu, B. C., Ogbonna, A. C., Chukwu, J. C. & Onunkwo, D. N. (2021). Nutritional evaluation of sundried pro-vitamins. A cassava tuber meal (*Manihot esculenta* crantz) supplemented with enzyme as energy source in broiler chicken production. *Nigerian Agricultural Journal,* 52(3), 302-309.

AOAC (1995).*Association of Official Analytical Chemists* (1995). Official Methods of Analysis, Washington DC, 15th ed.

AOAC (2005).*Association of Official Analytical Chemists* (1995). Official Methods of Analysis, Washington DC, 17th ed.

Brunner, J. H. (1984). Direct spectrophotometer determination of saponin *Analytical Chemistry,* 34, 1314-1336.

Cook, B., Pengelly, B., Brown, S., Donelly, J. Easgie, D., Franco, A., Handon, J., Mullen, B., Partridge, L., Peters, M. & Schultze-Kraft, R. (2005). Tropical forages: an interactive selection tool. Brisbane, Australia CSIRO, DPI and F (old), CIAT and ILRI.

Duncan, D. B. (1955). New multiple range test. *Biometrics,* 11, 1-42.

Egbo, M. L., Doma, U. D. & Lacdaks, A. B. (2001). Characteristics of small scale rabbit production and management in Bauchi Metropolis. *Proceedings of the 26th Annual conference of Nigerian Society of Animal Production (NSAP),* 18 – 21 March, 2001, ABU, Zaria. 160 – 162.

Food and Agricultural Organization (FAO) (2013). FAOSTAT. Trade year book. FAO Rome, Italy.

Food and Agricultural Organization (FAO), (1990). FAOSTAT. Trade year book. FAO Rome, Italy.

French, M. H. (1955). Feeding value of sweet potato tubers. L. *African Journal of Agricultural Research,* 121(I), 18-19.

Henry, T. A. (1993). *The Plant Alkaloids, pp. 6*-466.

Maga, J. A. (1982). Phytate, its chemistry occurrence, food interaction nutritional significance and method of analysis. *Journal of Agriculture and Food Chemistry,* (30)1.

Mohammed, A. & Agwunobi, L. N. (2008). Taro cocoyam (*Colocasiaesculenta*) meal as feed ingredients in poultry. *Pakistan Journal of Nutrition,* 8, 668-673.

NRCRI (2010). Agro-meteorological unit. National Root Crops Research Institute. Umudike, Umuahia. Nigeria

Nwosu, C. U. (2021). Dietary supplementation of diets containing sundried sweet potato (*Ipomea batatas*) waste meal with yeast additive on the growth performance of starter broiler chicks. *B. Agric. Thesis*. Michael Okpara University of Agriculture, Umudike, Sept. 2021.

Obua, B. E., Okocha, C. N. & Nwoha, L. E. (2012). Proximate composition and anti-nutritional factors of some forage species used in feeding rabbits in Umudike, humid south eastern, Nigeria. *International Journal of Agriculture and Rural Development,* 15(3), 1275-1286.

Osuagwu, C. (2006) The effect of graded levels of sweet potato meal in weaner rabbits diet. B. Agric. Project. College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike.

Shaahu, D .T. Abacky, A. & Tiough, S. M. (2020). Effect of replacing maize with composite cassava meal (CCM) on growth and economics performance of rabbit. *Nigerian Journal of Animal Production,* 44(2), 79-85.

Snedecor, G. W. & Cochran, W. G. (1989). Statistical methods, 8th Ed. IOWA State University Press.

Soetan, K. O. (2008). Pharmacological and other beneficial effects of anti-nutritional factors in plants. A Review. *African Journal of Biotechnology,* 7(25), 4173-4721.

Tewe, O. O. (1997). *Sustainability and development paradigm from Nigeria livestock ind*ustry. Inaugural lecture delivered on behalf of faculty of Agriculture and Forestry, University of Ibadan, pp. 50.