EFFECT OF VARYING LEVELS OF MERGED CASSAVA MEAL-BASED DIET ON GROWTH PATTERN, DIGESTIBILITY AND NITROGEN RETENTION OF WEANER RABBITS.

Ekwe, C.C.,[1] Ukachukwu, S.N.,[2] Nwabueze, I.[1] and Odoemelam, V.U.[3]
[1] *National Root Crops Research Institute, Umudike, Abia State, Nigeria.*
[2] *College of Animal Science and Animal Health, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria*
[3] *Department of Animal Science and Technology, Federal University of Technology, Owerri.*

ABSTRACT
An experiment was conducted to evaluate the effect of varying levels of merged cassava meal (MCM) on growth pattern, digestibility coefficient and nitrogen retention of rabbits. The MCM is a Mixture of milled unpeeled cassava root and milled cassava foliage at a ratio of 5:4. 24 Weaner rabbits were fed diets containing Merged Cassava Meal (MCM) at 0%, 10%, 20% and 30% inclusion levels designated Treatment 1, 2, 3 and 4 (T1, T2, T3 and T4) respectively in a completely randomized design (CRD).Each treatment had 3 replicates of 2 rabbits each. The experiment lasted 56 days. Data obtained were subjected to Analysis of Variance (ANOVA) and differences in treatment means were separated using Least significant difference (LSD) at 5% level of probability. Results showed that the feed intake of the rabbits in T4 (30% MCM) was significantly higher. Results for growth pattern also indicated that rabbits in T4 had better ($p<0.05$) final live weight and daily weight gain compared to rabbits in other treatments (T1, T2 and T3). Final and daily weight gain increased with increasing inclusion of MCM. Feed conversion ratio and protein efficiency ratio forT4 were also significantly better ($p<0.05$) compared to other treatments.Final live weight, average daily weight gain, and protein efficiency ratio followed the same trend as daily feed intake. Apparent digestibility and nitrogen retention results showed that T4 encouraged better ($p<0.05$) digestibility coefficient for dry matter (78.57%) and crude protein (85.50%) than other treatments. Rabbits in T4 had the highest ($P<0.05$) nitrogen retention (0.75g).It was concluded that among the four diets studied, 30% inclusion of MCM in the ration of Weaner rabbits gave the best resultin terms of digestibility coefficient, nitrogen retention and growth and is therefore recommended for Weaner rabbits.
Keywords: Merged Cassava meal, Rabbit, Growth, Digestibility, Nitrogen retention

INTRODUCTION

There exists a gap between the human requirement for animal protein and its supply in Nigeria (Ayorinde and Aromolaran, 1998). The scenario is generally attributed to shortfall in animal production (Akinmutimi,*et al.*,2006)occasioned mainly by scarcity and high cost of inputs in animal production (Oyenuga and Opeke, 1975). Consequently, there is high demand for the limited livestock products, leading to escalated cost. This has led to low level of animal protein consumption by average Nigerian. Odubote and Akinokun (1992) have made a case for rabbit production as a panacea to animal protein deficit in the diets of Nigerians. Aduku and Olukosi (1990) had earlier opined that the prolific nature and short gestation period of rabbit makes it the choice animal for rapid multiplication. Rabbits can be raised on high fibre feeds and materials not utilized by man. Ninety per cent of cassava produced in Nigeria is consumed locally and efforts are being made to fully explore and exploit the alternative uses of cassava products and by-products to maximize economic benefits and to diversify the foreign exchange earning sources for the country. Cassava has many uses which give the crop high potentials as a major foreign exchange earner in Nigeria. Cassava is a source of flour, starch, chips, paper, pellets, adhesive, livestock feeds, and a carrier for pharmaceutical, among others, (Federal Government of Nigeria, 2004).Cassava leaf has high protein content (from 16.7 to 39.9%) with almost 85% of the crude protein fraction as true protein (Ranvindran, 1991). It is a readily available product at the time of harvesting the roots. The limited supply, high cost and increasing demand of raw materials like grains for livestock feed industry has made it necessary to explore other feed materials that are locally available and relatively cheaper and can meet the nutritional requirements of the specific animal. The mergingof Cassava roots and the leaves will make feed for livestock cheaper and alleviate the problem of direct competition between livestock and humans for maize and other conventional grains (Ukachukwu,2005). Utilization of this feedstuff (MCM) by rabbits will surely contribute to production of the needed animal protein. Merged cassava meal can be a promising energy and protein supplement in feeding rabbits (Ukachukwu,2005). The aim of this study was therefore to determine the digestibility of diets compounded with the merged cassava meal by Weaner rabbits and alsoto determine the nitrogen retention of weaner rabbits fed such diets as well as effect on growth of rabbits.

MATERIALS AND METHODS

Experimental Animal: Twelve (24) cross bred (New Zealand White X Chinchilla) Weaner rabbits averaging

1.03kg in weight and aged between 6-8 weeks were used in a completely randomized design. They were assigned to four dietary treatments, each replicated three times with two rabbitsper replicate. The experiment lasted 56 days.

Housing and Equipment: The experimental hutch was made of wood and wire gauze. The hutch which was housed in a well ventilated pen had metal trays where the feacal droppings and urine were collected daily. These metal trays were cleaned everyday using broom, water, detergent, and Sponge. The hutches were partitioned with wooden plank and wire mesh. Each partition accommodated a rabbit. Aluminum drinkers and feeders were used in providing water and feed*ad libitum*.

Experimental Diets: Cassava roots and foliage were harvested from mature cassava plants grown at National Root Crops Research Institute, Umudike, in Abia State. The foliage were sun-dried until the leaves were crispy. The unpeeled cassava roots were washed with water, chipped, bagged and pressed for 24 hours fermentation and then sun-dried on a concrete floor. The dried chipped cassava roots and foliage were milled differently in a milling machine. The milled cassava roots were mixed with milled foliage at the ratio of 5:4. This mixture was named Merged Cassava Meal (MCM). The merged cassava meal was included in the diets at different levels; 0%(Treatment1), 10%(Treatment 2), 20%(Treatment 3) and 30% (Treatment 4) in the diets of Weaner rabbits. Treatment 1 (which is the control) was devoid of MCM.

Digestibility and Nitrogen Retention Trial: At the end of the experiment each Rabbit was taken to metabolic cage and the first 2 days were used as acclimatization period to get the rabbits used to the new environment. Thereafter, the rabbits were starved for 12 hours prior to the experimental feeding to clear the gut of the previous meals. This was followed by 10 days feeding during which their dropping and urine were collected. They were also starved for another 12 hours at the end of the feeding period to ensure total collection of faeces arising from the diet offered. Faeces and urine were collected separately on a daily basis. The faeces were sun-dried, weighed and put in a labeled bag and stored. Urine was also collected daily in a labeled container, with the record of the total weight and volume. An amount of 10% of each day's collection was stored in 10ml of 10% concentrated sulphuric acid to prevent nitrogen losses by evaporation of ammonia and help keep the urine pH below 4. The urine was stored in a refrigerator until required for analysis. At the end of 10 days collection period faeces from each replicate were mixed, ground and samples taken for proximate analysis. Urine from each replicate was mixed together and samples taken for nitrogen determination. Proximate composition of diets and faeces, and nitrogen in urine were determined according to the method of AOAC (1990).

Data Collection and Statistical Analysis: Initial average weight of the rabbits was taken on the first day and subsequently weight gain was taken on weekly basis, data was collected daily on feed intake and used to calculate feed conversion ratio (FCR) and protein efficiency ratio (PER). Data obtained were subjected to analysis of variance (ANOVA) in a completely randomized design (Steel and Torrie, 1980). Differences among the treatment means were separated using least significant difference (LSD).

Table 1: Percentage Composition of Experimental Diets Containing Graded Levels ofMerged Cassava Meal.

Ingredients	T1T2 T3 (0% MCM)	T4 (20% MCM)	(20% MCM)	(30% MCM)
Maize,%	48.79	42.47	36.00	29.72
MCM,%	0.00	10.00	20.00	30.00
Wheat offal,%	32.34	28.66	25.86	21.41
Groundnut cake,%	10.27	10.27	10.27	10.27
Fish meal,%	4.85	4.85	4.85	4.85
Bone meal,%	3.00	3.00	3.00	3.00
Vit./Min. Premix,%	0.25	0.25	0.25	0.25
Salt,%	0.50	0.50	0.50	0.50
Total	100	100	100	100
Calculated				
crude protein,%	18.01	17.98	17.96	17.94
ME, Kcal/kg	2702	2669	2666	2651
Crude fibre,%	4.62	6.37	8.12	9.88

Composition per 2.5kg (Bio Mix) Premix: Vitamins A (500,000IU), D3 (100,000IU), E, (2,000mg), K3(100mg), B1 (120mg), B2 (240mg), Niacin (1,600mg), Calcium pantothenate (400mg), Biotin (3.3mg), B12 (1.0mg), Folic

acid (40mg), Choline chloride (12,000mg), manganese (4,000mg), Iron (2,000mg), Zinc (1,800mg), Copper (80mg), Iodine (61mg), Seleniurn (4mg), Growth Promoter (1,600mg), Antioxidant (8,000mg).
MCM= Merged Cassava Meal, ME= Metabolizable energy.

Table 2: Proximate Composition of Experimental Diets Containing Graded Levels of Merged Cassava Meal

Proximate Components	T1 (0%MCM)	T2T3 (10%MCM)	T4 (20%MCM)	(30%MCM)
Dry matter	92.74	93.56	93.60	93.64
Crude protein	20.08	20.73	21.70	22.53
Crude fibre	8.70	9.75	9.90	10.25
Ether Extract	3.15	3.40	3.85	4.20
Nitrogen free extract	54.56	52.83	51.25	49.01
Ash	6.25	6.85	6.90	7.65

MCM= Merged Cassava Meal.

RESULTS AND DISCUSSION

Growth Performance

Table 3 shows performance of growing rabbits fed diets containing the different levels of merged cassava meal. Significant differences (P<0.05) were observed for average daily feed intake among the treatment means. Treatments 4(40.62g), 3(40.51g), 2(39.70g) and 1(36.47g) were significantly different (P<0.05) from each other. Treatment 4 had the highest (p<0.05) value followed by treatments 3, 2, and 1 respectively. This shows that the rabbits consumption increased as the level of MCM increased. As MCM inclusion level increases, dietary fibre level also increases. This may have encouraged higher consumption of the diets with higher MCM inclusion. Since higher dietary fibreresults to energy dilution of the diets, the rabbits had to consume more to meet their energy requirement. This agrees with the report of Sandford (1986) that growing rabbits adjusted their feed intake according to energy and crude fibre content of the feed given to them. Higher crude protein in the diets is also considered an important factor that enables high intake of feed. This is in line with the observation of Babayemi*et al* (2006) and Oldham and Alderman (1980) that sometimes *ad libitum* intake by the animal is increased by an increased crude protein content of the diet. The incorporation of leafs may have made possible the improvement of the protein level and amino acid profile of the MCM.

Table 3: Growth Pattern of Weaner Rabbits Fed Graded Levels of Merged Cassava Meal - based Diet.

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	SEM
Mean Initial Weight (kg)	1.03	1.04	1.03	1.02	0.01
Mean final Weight (kg)	2.06^{d}	2.09^{c}	2.20^{b}	2.34^{a}	0.08
Av. Daily feed Intake (g)	36.47^{d}	39.70^{c}	41.51^{b}	42.62^{a}	0.76
Av. Daily weight gain (g)	12.30^{d}	12.50^{c}	13.93^{b}	15.71^{a}	0.92
Feed conversion ratio	3.06^{b}	3.19^{a}	2.91^{c}	2.58^{d}	0.19
Protein Efficiency Ratio	1.80^{b}	1.62^{d}	1.69^{c}	1.83^{a}	0.10

SEM=Standard error of difference of means.

There were significant differences (p>0.05) among the treatments for mean final live weight and average daily weight gain (DWG) as well as in feed conversion ratio (FCR) and protein efficiency ratio (PER). The mean final live weight ranged from 2.06kg/rabbit (in the 0% MCM group) to 2.34kg/ rabbit (in the 30% MCM group). Also T4 (30%MCM group) had the highest (p<0.05) value (15.71g) for daily weight gain while T1 (0%MCM group) had the lowest (12.30g). These two parameters followed similar trend of increasing value as the MCM level increased. The increases in the live-weight and daily weight gain could be due to increase in the consumption levels. Significant differences (p<0.05) were observed for feed conversion ratio (FCR) and protein efficiency ratio (PER) among treatment means. Treatment 4 (2.58) wasbetter (p<0.05 than treatment 3(2.91), 2(3.19) and the control (3.06). protein efficiency ratio (PER) followed the same trend with treatment 4 (1.83), treatment 3 (1.69), treatment 2 (1.62) and the control (1.80). It is also evident that the FCR and PER followed the same trend as the feed intake and the MCM inclusion level increased. The FCR and PER are indices of feed and protein utilization, respectively. It has also been noted earlier that increased levels of MCM resulted to increased dietary crude fibre and dietary crude protein. Higher dietary crude fibre encourages caecotrophy which in turn enhances feed utilization in rabbits. Champe and Maurice (1983) had reported that rabbits require a level of crude fibre in excess of 9% for normal growth and to encourage caecotrophy. Also, increased dietary protein encourages better feed conversion ratio and protein efficiency ratio. Generally the incorporation of dried cassava foliage into the MCM could have enhanced the utilization of the diets by the rabbits. The foliage contributed crude protein to balance the protein: energy ratio of the diets. The result agrees with the suggestion of Akinfala*et al* (2003) that incorporation of dried cassava foliage could enhance the metabolism and utilization of cassava roots. Furthermore the rabbits were able to handle and tolerate the toxic and inhibitory substance (HCN) contained in the MCM based diet. Aletor and Fasuji (1997) reported the presence of anti-nutritional factors in cassava (cyanogenic glycosides), which on hydrolysis, release hydrogen cyanide (HCN), a substance that causes marked weight reduction. It is possible that the mode of action of the microbes in the alimentary system of the rabbits may have acted on the toxic and inhibitory substance in the MCM-based diet. The report of Fielding (1991) agrees that rabbit possess microbes in the alimentary system that can counteract the effect of toxic and inhibitory substances in their diets.

Apparent Digestibility of Nutrients

Table 4shows theeffect of graded levels of merged cassava meal-based diets on the digestibility coefficients of feed nutrients. No significant differences (p>0.05) were observed for dry matter (DM), ether extract (EE) and nitrogen free extract (NFE) among treatment means. For dry matter, the range of the digestibility coefficients was from 78.18% (T2) to 78.57% (T4) with an average of 78.39%. For ether extract (EE) the digestibility coefficient ranged from 85.72 (T4) to 87.58% (T1-control), with an average of 86.28%. For nitrogen free extract the range of the digestibility coefficients was from 80.45% (T4) to 80.81% (T2) with an average of 80.58%.

Table 4:Effect of Graded Levels of Merged Cassava Meal-based Diets on the Apparent Digestibility of Nutrients.

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	SEM
Dry matter %	78.44	78.18	78.37	78.57	0.26
Crude Fibre %	56.43^{a}	59.55^{a}	58.29^{a}	52.88^{b}	0.99
Crude Protein %	80.85^{c}	79.12^{d}	82.37^{b}	85.50^{a}	0.44
Ether Extract %	87.58	86.67	86.95	85.72	0.56
Nitrogen Free Extract %	80.61	80.81	80.46	80.45	0.53

SEM=Standard error of difference of means.

There were significant differences (P<0.05) in the digestibility coefficients among the treatments for crude fibre (CF) and crude protein (CP).For crude fibre digestibility coefficients of treatments 1(56.43%), 2(59.55%), and 3(58.29%) were statistically the same (P>0.05) but higher (P<0.05) than that of treatment4 (52.88%). As the level of MCM increased in treatment 2, 3 and 4 the digestibility of crude fibre decreased. This could also be attributed to the rapid passage of the diet through the gut due to higher level of fibre in the diet, since high fibre level encourages bowel movement (Van Beresteyn*et al.,* 1979). For crude protein (CP) digestibility coefficients, there were significant differences (P<0.05) among the treatment means. It ranged from 79.12% in treatment 2 to 85.5% in Treatment 4. The dietary protein level could have direct influence on the protein digestibility of the diet. Davidson and Spreadburg (1977) hadreported that there is a significant correlation between the protein content of feed and crude protein digestibility.

Table 5 shows the nitrogen balance of the MCM-based diet by the growing rabbits. For nitrogen intake, there were significant differences among the treatment means. Itranged from 1.09g in treatment 1 to1.37g in treatment 4. Nitrogen intake increased as the level of MCM increased. This reveals that as MCM increased consumption of protein also increased which is in agreement with the report of Amaefule*et al* (2006) that the differences in nitrogen intake could be attributed to the crude protein content of diets.

Table 5: Nitrogen Balance of Weaner Rabbits Fed Graded Levels of Merged Cassava Meal-Based Diet

Parameters	T1 (0%)	T2 (10%)	T3 (20%)	T4 (30%)	SEM
Nitrogen Intake (g)	1.09[c]	1.23[b]	132[a]	1.37[a]	0.02
Feacal Nitrogen (g)	0.57[b]	0.64[a]	0.56[b]	0.49[c]	0.02
Urine Nitrogen (g)	0.23[b]	0.29[a]	0.20[b]	0.13[c]	0.02
Digested Nitrogen (g)	0.51[c]	0.59[c]	0.76[b]	0.88[a]	0.04
Nitrogen Retention (g)	0.28[c]	0.30[c]	0.56[b]	0.75[a]	0.05
Retention as % Intake	25.47[b]	24.69[b]	42.24[a]	54.99[a]	4.37
Retention as % of Digested	51.88[b]	51.18[b]	73.43[ab]	85.29[a]	7.20

SEM=Standard error of difference of means.

Significant differences were observed for digested nitrogen. It ranged from0.51g in treatment 1 to 0.88g in Treatment 4. As the level of MCM increased digested nitrogen also increased. Kidder and Maners (1978) had reported that the digestibility of a particular protein will vary to some extent according to the level of feeding and other constituents of the diet. Significant differences ($P<0.05$) were also observed for nitrogen retention. Nitrogen intake significantly ($P<0.05$) influenced digested nitrogen and nitrogen retention. It was observed that as digested nitrogen and nitrogen retention increased among the treatments the crude protein digestibility coefficient also increased. The increases observed in the digested nitrogen and nitrogen retention could be as a result of the influence of digested crude protein. There were significant differences ($P<0.05$) among the treatment means for retention as percent of nitrogen intake and retention as percent of nitrogen digested. For retention as percent of nitrogen intake, it ranged from 24.69 intreatments 2 to 54.99 in treatments 4. Retention as percent of nitrogen digested followed, the same trend with retention as percent of nitrogen intake. In this study, differences in nitrogen intake resulted in significant differences in digested nitrogen, nitrogen retention, retention as percent of nitrogen intake and digested suggesting that differences in nitrogen intake were biologically important.

CONCLUSION

Treatment 4 was better ($p<0.05$) than other treatments in terms of growth pattern which includes final weight, daily weight gain and feed conversion ratio. It also gave the highest ($p<0.05$) dry matter digestibility coefficient and crude protein digestibility coefficient of Weaner rabbits. This high digestibility of crude protein encouraged better growth pattern of the rabbits. Treatment 4 also gave the highest nitrogen retention which could have influenced high daily weight gain, feed conversion ratio and protein efficiency ratio of rabbits. In consideration of the aforementioned, it could be concluded therefore that 30% inclusion of MCM in the ration of Weaner rabbit gave the best results among the four rations compared both in digestibility coefficient and nitrogen retention as well as growth pattern.

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