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CASSAVA AS NEW ANIMAL FEED IN EGYPT 3 - PELLETED COMPLETE CASSAVA FEED FOR GROWING RABBITS.

ABD EL-BAKI S.M., NOWAR M.S., BASSUNY S.M., HASSONA E.M., SOLIMAN E.S.

Department of Animal Production, Faculty of Agriculture
Zagazig University - ZAGAZIG - Egypt.

SUMMARY :
Forty New Zealand White rabbits (20 males and 20 females) aged 5 weeks, of 735g in average weight, were divided into two groups on basis of weight and sex. A pelleted complete rabbit feed containing 45 % cassava products (CCF diet) as 30 % root meal + 15 % leaf meal, was formulated to be fed in comparison with a commercial feed (AF diet ; Atmida C°) during the 15 weeks of experiment, divided in 3 stages of 5 weeks. 1 % urea was added to the CCF diet in order to increase the N-content. The results indicated that CP digestibility and N-balance of CCF were significantly ($P<0.05$) lower than that in AF diet in the first 5 weeks after weaning (1st stage). But the CP digestibility and N-balance were not significantly different between two groups fed CCF and AF diets at 15 weeks after weaning (3rd stage). The CF digestibility was not significantly affected by type of feed and it was improved by advance in age of rabbits fed CCF or AF diets. In contrast N-balance was decreased with advancing of age of two groups of growing rabbits. No significant effect of sex was observed on digestibility or N-balance. The feed intake was significantly ($P<0.01$) lower with CCF diet than that with AF diet in 1st and 2nd stages. Daily body gain was significantly ($P<0.01$) lower with rabbits fed CCF than those fed AF diets in 1st stage but it was nearly similar between two groups at 2nd and 3rd stages. Feed conversion (feed/gain) was more efficient with rabbits fed AF than those fed CCF diets at 1st stage but opposite trend was observed in 2nd and 3rd stages of growth. Slaughter and carcass traits showed no significant differences between the two groups fed CCF and AF diets. There were no significant differences in feed intake, feed conversion and daily body gain between male and female rabbits. Conclusively, it could be appear that cassava products (roots and leaves) can be used satisfactorily as the partial substitute for traditional energy and protein supplements to formulating pelleted diet for growing rabbits.

RESUME : Un nouvel aliment animal en Egypte : le Manioc. 3 - Un aliment granulé complet à base de manioc pour lapins en croissance.
Quarante lapins Néo-zélandais Blancs (20 mâles et 20 femelles) âgés de 5 semaines, pesant en moyenne 735g ont été divisés en deux groupes compte tenu de leur sexe et de leur poids. Ils ont reçu au cours des 15 semaines d'expérience, soit un aliment granulé complet (CCF) contenant 45 % de manioc (30 % de farine de racines et 15 % de farine de feuilles) soit un aliment complet (Atmida C[e]) du commerce (AF). 1 % d'urée a été ajouté au régime CCF afin d'augmenter la teneur en azote. Les résultats indiquent que la digestibilité des PB et le bilan azoté du régime CCF étaient significativement plus bas que ceux du régime AF dans les 5 premières semaines après le sevrage (1ère période). Mais la digestibilité des PB et le bilan azoté n'étaient pas significativement différents entre les deux groupes (CCF et AF) 15 semaines après le sevrage (3ème période). La digestibilité de la cellulose brute n'était pas affectée par le régime, par contre, elle s'est améliorée avec l'âge. A l'inverse, le bilan azoté s'est dégradé avec l'âge, au sein des deux lots. Aucun effet de sexe n'a été observé pour la digestibilité ou le bilan azoté. La consommation était significativement plus basse ($P<0.01$) avec le régime CCF qu'avec le régime AF au cours des 1ère et 2ème périodes. Le gain de poids journalier était significativement plus bas avec l'aliment CCF qu'avec l'aliment AF au cours de la première période mais il était presque identique dans les deux groupes au cours des 2ème et 3ème périodes. L'efficacité alimentaire était supérieure avec l'aliment AF comparé à l'aliment CCF pendant la première période, mais une tendance contraire a été observée durant la 2ème et 3ème périodes de croissance. Les caractéristiques d'abattage et de carcasse ne présentaient pas de différences significatives entre les deux groupes. Il n'y avait pas de différences significatives entre mâles et femelles concernant la consommation, l'indice de consommation et le gain de poids journalier. En conclusion il apparait que le manioc (feuilles et racines) peut être utilisé de manière satisfaisante comme substitut partiel des composants traditionnels énergétiques et azotés dans des formules d'aliments granulés pour lapins en croissance.

INTRODUCTION

Cassava products has been widely used during the last decade as an animal feed. Several workers have reported that cassava root meal can be used as a source of energy in poultry and pigs diets (ENRIQUEZ and ROSS, 1967, 1972 ; DEVENDRA and HEW, 1977 ; RICHTER *et al.*, 1987, 1988). Similar reports have been made on including cassava leaf meal as partial substitute for traditional protein source in chick and pig diets (EGGUM, 1970 ; HUTAGALUNG, 1972 ; HUTAGALUNG et al., 1973, 1974). Also, different levels of cassava products were evaluated by ruminants (TUDER and NORTON, 1982). In recent years in Egypt ABD EL-BAKI *et al.* (1986, 1989, 1990) cultivated and

evaluated cassava products for ruminants. However, in rabbits nutrition, limited information is available on the use of cassava products.

The purpose of the present study was to formulate and evaluate a pelleted diet based on cassava products for growing rabbits.

MATERIALS AND METHODS

The present experiment was conducted at National Rabbit Project Farm, Department of Animal Production, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

Cassava was cultivated in the Farm of the same Faculty. Cassava leaves were harvested 8 months after planting and then sun dried. The experimental diets were pelleted in the Feed Plant of Atmida Poultry Company, Atmida, Dakahilia Governorate, Egypt. The commercial pelleted diet (AF) was obtained from the same Atmida Company. Ingredients and chemical composition of the pelleted feeds and the cassava products are presented in Table 1. It was chosen to use 30 % of cassava roots meal as cheap source energy, and 15 % of cassava leaves meal and 1 % urea as a cheap nitrogen sources in formulating the experimental feed (CCF). Crude protein content on DM basis was 17.4 % in experimental feed (CCF) *vs* 21 % in commercial feed. The main objective of this study was comparison between the experimental diet and the commercial one considered as a control diet.

Forty New Zealand White rabbits (20 males and 20 females) aged 5 weeks (at weaning time) 735g in average of body weight divided into two feeding groups on basis of body weight and sex. The rabbits were kept in individual cage. Feeds were offered *ad libitum* and water was available all time by automatic system. All rabbits were kept under the same managerial, hygienic and environmental conditions. Individual live body weight and feed consumption were weekly renewed through 15 weeks after weaning date.

Twelve metabolism trials for digestibility and N–balance were carried out during experimental period at 5^{the}, 10^{the} and 15^{the} week of weaning for males and females (3 periods x 2 sexes x 2 feeds) by using 3 rabbits in each trial. Each trial lasted 5 days of collection period for digestibility and N–balance.

Table 1 : Ingredients and chemical composition of experimental diets for growing rabbits.

	Diets	
	Cassava feed	Commercial feed
Ingredients :		
Berseem hay	14	28
Barley grain	20	32
Cassava root meal	30	–
Cassava leaf meal	15	–
Soybean meal 44 %	–	10
Decorticated cotton seed meal	–	3
Linseed meal	15	–
Molasses	2.70	3
Wheat bran	–	21
Meat meal (60 %)	–	1.30
Urea	1	–
Lime stone	1	1
Sodium chloride	0.5	0.34
$NaHPO_4$	0.4	–
Vitamins and mineral mix.	0.34	0.30
DL-Methionine	0.06	0.06

Proximate analysis (% DM basis)

Feeds	DE	DM	OM	CP	CF	EE	NFE	Ash
Cassava Feed	2.87	90.25	88.70	17.45	16.29	3.32	51.64	11.30
Commercial Feed	2.86	89.55	90.28	21.01	18.20	2.79	48.28	9.72
Cassava roots		89.40	95.75	5.15	3.97	1.56	85.07	4.25
Cassava leaves		91.55	86.55	18.16	20.33	7.26	40.80	13.45

At the end of the experimental period, 4 fasted rabbits from each group were randomly taken for slaughter to study carcass traits.

Chemical composition of cassava products, rations, feces, urine and meat samples, were analysed according to A.O.A.C. (1980). Data were statistically analysed according to SNEDECOR and COCHRAN (1982).

RESULTS AND DISCUSSION

1 - Digestibility and nutritive value.

When the two different diets were compared, the results of digestibility (Table 2, 3 and 4) showed that the CP digestibility of pelleted complete cassava feed, which contains 1 % urea, was significantly ($P<0.05$) lower than that in Atmida commercial feed at 5th (1st stage) and 10th (2nd stage) weeks of weaning. Similar results were reported by HOOVER and HEITMANN (1975) and EL-SERAFY *et al.* (1981) who found that CP digestibility decreased when growing rabbits fed diet containing urea. This result may be attributed to the very limited value of urea as nitrogen source for fryer rabbits (KING, 1971 ; CHEEKE, 1972 ; LEBAS and COLIN, 1973). BECAUSE the nitrogen digestibility of the CCF diet was no longer different from that one of AF diet during the 3rd stage, it can be concluded that the N–digestibility in CCF diet was relatively improved with increasing of rabbit age. This result may indicate that urea utilization was improved by older rabbits. These findings are in harmony with those of LEBAS (1973). Effectively, urea hydrolysing bacteria (Ureolytic) are present in the adult rabbit cecum (CROCIANI *et al.*, 1984) and some micro-organisms are able to utilize ammonia for aminoacid synthesis. KENNEDY and HERSHBERGER (1974) also indicated that fermentation processes and synthesis of bacterial protein in cecum were increased gradually by advance in age. In addition, CHEEKE (1987) reported that synthesis of bacterial protein in the cecum and subsequent consumption of the cecal contents by caecotrophy would suggest an ability of rabbits to utilize nonprotein nitrogen (NPN) sources such as urea. The CF digestibility was not significantly affected by the type of diet at the 3 stages of growth period.

The digestible crude protein (DCP) value of AF diet was significantly higher than that in CCF diet during the 3 stages of growth. This may be due to the higher content of CP in AF (21.01 %) than in CCF (17.45 %).

The N–balance during the 5th week after weaning was significantly ($P<0.05$) higher by rabbits fed the AF diet than those fed the CCF one. However, the differences in N-balance were not significant between the two types of feed at the 10th or 15th week after weaning as shown in Tables 2, 3 and 4.

Tableau 2 : Digestibility, nutritive value and N-balance of both diets in New Zealand White growing rabbits at 5 weeks after weaning.

	Commercial feed		Cassava feed	
	Males	Females	Males	Females
Digestion coefficients (%)				
DM	67.70 ± 1.55	67.87 ± 1.71	68.44 ± 1.02	68.25 ± 1.74
OM	68.66 ± 1.69	69.06 ± 1.60	70.15 ± 0.82	70.56 ± 1.82
CP	76.03 ± 1.08[a]	76.69 ± 2.88[a]	68.78 ± 1.74[b]	69.33 ± 3.08[b]
CF	21.69 ± 1.07	21.64 ± 1.47	21.72 ± 3.38	20.57 ± 3.41
EE	78.42 ± 0.50[a]	74.69 ± 3.17[a]	70.45 ± 1.20[b]	68.99 ± 2.24[b]
NFE	82.57 ± 2.71[a]	83.31 ± 1.16[a]	86.00 ± 0.37[b]	86.98 ± 1.73[b]
Nutritive value (% DM)				
DCP	15.97 ± 0.23[a]	16.11 ± 0.61[a]	12.00[b] ± 0.30	12.10[b] ± 0.54
N- balance				
N-intake (g/day)	2.87 ± 0.17	2.96 ± 0.58	1.98 ± 0.17	1.96 ± 0.14
Faecal-N (g/day)	0.69 ± 0.03	0.71 ± 0.21	0.57 ± 0.04	0.56 ± 0.06
Urinary-N (g/day)	0.91 ± 0.08	0.99 ± 0.25	0.50 ± 0.11	0.46 ± 0.09
N-balance g/head/day	1.27 ± 0.08[a]	1.26± 0.14[a]	0.91 ± 0.03[b]	0.93 ± 0.07[b]
Balance % N-intake	44.3 ± 0.8	42.6 ± 4.4	46.0 ± 3.1	47.7 ± 2.8

[a,b] Means in same row with different superscripts differ ($P<0.05$).

Table 3 : Digestibility, nutritive value and N-balance of both diets in New Zealand White growing rabbits 10 weeks after weaning.

	Commercial feed		Cassava feed	
	Males	Females	Males	Females
Digestion coefficients (%)				
DM	69.93 ± 0.89	69.32 ± 1.40	71.34 ± 3.89	70.96 ± 2.47
OM	71.28 ± 0.88	70.90 ± 1.33	72.89 ± 3.20	72.64 ± 2.52
CP	76.94 ± 1.20[a]	77.12 ± 1.04[a]	70.89 ± 4.92[b]	69.43 ± 3.23[b]
CF	21.93 ± 0.70	21.57 ± 0.53	23.22 ± 1.96	23.06 ± 1.23
EE	74.90 ± 1.58[a]	75.21 ± 2.19[a]	70.76 ± 4.66[b]	70.48 ± 2.08[b]
NFE	86.50 ± 1.19	86.54 ± 1.80	89.24 ± 2.98	89.74 ± 2.17
Nutritive value (% DM)				
DCP	16.16 ± 0.25[a]	16.20 ± 0.22[a]	12.37 ± 0.86[b]	12.11 ± 0.57[b]
N-balance				
N-intake (g/day)	3.16 ± 0.24	3.09 ± 0.24	2.36 ± 0.21	2.37 ± 0.24
Faecal-N (g/day)	0.69 ± 0.07	0.70 ± 0.05	0.71 ± 0.18	0.71 ± 0.01
Urinary-N (g/day)	1.53 ± 0.15	1.15 ± 0.19	0.72 ± 0.10	0.74 ± 0.16
N-balance/g/head/day	0.91 ±0.13	0.94 ± 0.01	0.93 ± 0.02	0.92 ± 0.04
Balance % from N-intake	28.8 ± 1.3	30.4 ± 2.2	39.4 ± 3.8	38.8 ± 4.5

[a,b] Means in same row with different superscripts differ (P<0.05)

The data of digestibility trials showed that there were no significant effect of sex on digestibility values of nutrients and N–balance during the 3 stages of growth of rabbits. These results are in agreement with those reported by EL-GENDY (1993) who showed that no significant differences between males and females of NZW rabbits in digestibility of nutrients and N–balance.

2 - Growth performance

Feed intake

Results of average feed intake indicated (Table 5) that feed intake was lower with pelleted cassava feed than with Atmida feed. Similar results were obtained by OMOLE and OMAIDIK (1983) and SHALASH *et al.* (1987). Similarly, RICHTER *et al.* (1988) reported that feed intake dropped in chickens, pullets and laying hens when their feeds contained more than 10 % cassava root meal. On the other side, ESHIETT *et al.* (1980) found that the feed intake with rabbits was not affected with the different levels of cassava root meal (0 – 45 %)

Daily body gain (DBG)

The average daily body gain during the 1st stage of growth was significantly (P<0.05) higher with AF than with CCF diet (Table 5). The lower DBG in 1st stage, of rabbits fed CCF diet than that observed with the AF diet may be due to the decrease of

Table 4 : Digestibility, nutritive value and N-balance of both diets in New Zealand White growing rabbits 15 weeks after weaning.

	Commercial feed		Cassava feed	
	Males	Females	Males	Females
Digestion coefficients (%)				
DM	61.53 ± 0.69[a]	61.13 ± 1.10[a]	63.83 ± 1.70[b]	64.79 ± 1.78[b]
OM	63.93 ± 0.38[a]	63.99 ± 0.94[a]	67.13 ± 1.52[b]	67.62 ± 1.52[b]
CP	71.03 ± 0.29	72.21 ± 0.23	71.31 ± 0.70	70.79 ± 2.03
CF	24.12 ± 3.60	23.80 ± 2.72	26.02 ± 2.49	26.35 ± 2.32
EE	71.78 ± 1.63	71.76 ± 2.40	71.67 ± 1.04	71.47 ± 0.89
NFE	75.40 ± 1.11[a]	75.12 ± 1.35[a]	82.81 ± 1.57[b]	83.76 ± 0.44[b]
Nutritive value (% DM)				
DCP	14.92 ± 0.06[a]	15.17 ± 0.05[a]	12.44 ± 0.12[b]	12.36 ± 0.35[b]
N-balance				
N-intake (g/day)	3.54 ± 0.31	3.78 ± 0.58	3.35 ± 0.11	3.04 ± 0.34
Faecal-N (g/day)	1.03 ± 0.08	1.05 ± 0.17	0.96 ± 0.05	0.87 ± 0.05
Urinary-N (g/day)	1.97 ± 0.21	2.20 ± 0.34	1.87 ± 0.08	1.60 ± 0.26
N-balance/g/head/day	0.54 ± 0.01	0.53 ± 0.04	0.52 ± 0.04	0.56 ± 0.04
Balance % from N-intake	15.2 ± 1.1	14.0 ± 1.6	15.5 ± 1.5	18.4 ± 1.3

[a,b] Means in same row with different superscripts differ (P<0.05).

Table 5 : Daily feed intake, body gain and feed conversion ratio of New Zealand White growing rabbits fed both pelleted cassava feed (CCF) or commercial feed (AF) in different stages of growth after weaning.

Criteria and stages	Commercial feed			Cassava feed		
	Males	Females	Mean	Males	Females	Mean
Feed intake (g)						
1st (0 - 5 weeks)	86.0 ± 2.3[a]	84.0 ± 1.8[a]	85.0[a]	62.0 ± 1.2[b]	66.0 ± 2.0[b]	64.0[b]
2nd (5 - 10 weeks)	107.0 ± 3.2[a]	108.0 ± 3.0[a]	107.5[a]	95.0 ± 4.7[b]	95.0 ± 1.2[b]	95.0[b]
3rd (10 - 15 weeks)	104.0 ± 3.9	93.0 ± 7.6	98.5	87.0 ± 0.9	88.0 ± 4.5	87.5
Average (0 -15 weeks)	99.0	95.0	97.0	81.3	83.0	82.2
Daily body gain (g)						
1st (0 - 5 weeks)	29.0 ± 1.1[a]	30.0 ± 3.2[a]	29.0[a]	20.0 ± 1.3[b]	20.0 ± 1.3[b]	20.0[b]
2nd (5 - 10 weeks)	19.0 ± 1.3	20.0 ± 1.0	19.5	19.0 ± 2.4	19.0 ± 1.4	19.0
3rd (10 - 15 weeks)	12.0 ± 1.0	11.0 ± 1.4	11.5	11.0 ± 0.6	12.0 ± 0.6	11.5
Average (0 - 15 weeks)	20.0	20.3	20.2	16.7	17.0	16.8
Feed conv.ratio (feed/gain)						
1st (0 - 5 weeks)	2.97 ± 0.12[a]	2.80[a]± 0.03[a]	2.88[a]	3.10 ± 0.14[b]	3.30 ± 0.17[b]	3.20[b]
2nd (5 - 10 weeks)	5.63 ± 0.38	5.40 ± 0.32	5.51	5.00 ± 0.50	5.00 ± 0.37	5.00
3rd (10 - 15 weeks)	8.66 ± 0.35	8.45 ± 0.36	8.56	7.91 ± 0.46	7.33 ± 0.60	7.61
Average (0 - 15 weeks)	5.75	5.55	5.65	5.34	5.21	5.27

[a,b] Means in same row with different superscripts differ (P<0.05)

daily feed intake and the presence or urea which may not be efficiently utilized by growing rabbits. These results were in accordance with those of KING (1971), CHEEKE (1972), LEBAS and COLIN (1973). However, the differences in DBG were not significant between groups fed CCF and AF diets at 2nd and 3rd stages of growth. This result may be attributed to the previous explanations reported by KENNEDY and HERSHBERGER (1974), CROCIANI *et al.* (1984) and CHEEKE (1987). In addition, it could be indicated that the relative increasing of feed intake and digestion coefficient of nutrients of rabbits fed CCF diet during 2nd and 3rd stages of growth period when compared with 1st stage led to absence of significant effect of feed type.

Feed conversion ratio (Feed/gain)

The differences of feed conversion ratio were not significant between AF and CCF, except during the 1st stage which showed a significantly (P<0.05) improved feed conversion with AF when compared with CCF. These results were in agreement with those of OMOLE and ESHIETT (1976) and ESHIETT *et al.* (1980), who reported that the average rate of gain and feed conversion did not differed significantly with different levels of cassava root meal.

The results of growth performance showed that there were no significant effect of sex on growth performance (Table 5) such as daily feed intake, daily body gain and feed conversion. Similar results were reported by EL-GENDY (1993).

Carcass traits

Data of carcass characteristics are presented Table 6. The results showed that there were no significant differences in the carcass traits between two groups of rabbits. The same trend was observed by SHALASH *et al.* (1987). Similarly, FOMUNGAN *et al.* (1984) found that diet containing different levels of cassava or grains did not affect the carcass yield of young rabbits.

Chemical analysis showed that cassava products did not scored any significant changes in the chemical composition of meat except ether extract percentage which was significantly (P<0.05) higher with cassava feed than with AF.

Table 6 : Carcass traits (X ± SE) in rabbits fed the experimental diets.

	Commercial feed	Cassava feed
Number of rabbits	4	4
Carcass weight (kg)	1.70 ± 0.12	1.44 ± 0.03
Dressing %	58.2 ± 4.11	57.6 ± 1.20
Carcass composition (%)		
Fore-limbs	14.5 ± 0.55	13.5 ± 0.36
Trunk	18.7 ± 0.72	16.8 ± 0.68
Hind-limbs	18.8 ± 0.82	20.6 ± 0.56
Chemical composition %		
Moisture	72.12 ± 1.08	75.26 ± 0.89
Protein	23.11 ± 0.79	21.10 ± 0.80
Fat	1.26 ± 0.13[a]	1.99 ± 0.11[b]
Ash	1.88 ± 0.22	1.48 ± 0.40

[a,b] Means in the same row with different superscripts differ (P<0.05).

CONCLUSION

It could be concluded from the previous data that cassava products (roots for energy and leaves for protein) are suitable ingredients to produce pelleted complete feed for growing rabbits.

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