USE OF SIMPLIFY DIET WITH CASSAVA BY PRODUCTS FOR RABBITS

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ABSTRACT

The performance and the carcass quantitative characteristics of 144 New Zealand White rabbits were evaluated from weaning to slaughtering (31 to 70 d of age) whose does were fed with control or experimental cassava diets. This latter diet was prepared with cassava meal from peeling roots obtained from floor wastes in the industrial processing line and hay made with the upper-third of the plant foliage, representing in total 80% of the diet volume. At weaning the rabbits were allocated in the iron cages, in a factorial arrangement 2 x 3 (two diets for mothers and litters before the weaning combined with three diets from weaning to slaughter) with 12 replications of two animals (one female and one male) per experimental unit. The two experimental (simplified) diets were formulated with the upper third of cassava foliage hay (41.6%) and cassava meal wastes ensiled or not (40%), representing a total of more than 80% of the diet. Rabbits from mothers which were fed with the maternity cassava diet weighed less at weaning than rabbits from control does (526 vs. 758 g; P<0.001). Independently of diets offered after the weaning, these animals had lower live weight at 50 and 70 days, but average daily growth was similar for the two groups: 38.7 and 38.6 g/d between 31 and 70 days for the control and the maternity cassava diet respectively. A significantly lower feed intake (P=0.007) was observed for rabbits which received the maternity cassava diet until weaning (129 vs. 138 g/d) resulting in a lower feed:gain ratio (3.03 vs. 3.22; P<0.001) during the fattening period. From weaning to slaughter, the use of cassava diets reduced significantly the growth performance of rabbits (36.8 and 37.3 g/d with non-ensiled and ensiled cassava vs. 41.8 g/d for the control) and feed intake (116 and 108 g/d vs. 137 g/d). Similarly carcass weight and slaughter yield were reduced with non-ensiled or ensiled cassava (52.9% and 52.6% vs. 53.8% for the control). The silage process improved significantly the feed:gain ratio (2.92 vs. 3.16 with non ensiled cassava and 3.28 for the control) in relation with of a lower feed intake, but there was non-significant effect of silage processing on average rabbits growth rate and carcass characteristics. The carcass cuts were heavier (P<0.01) for animals fed on control diet. Nevertheless hindlegs and forelegs proportions were higher with the cassava diets (P<0.01). The silage process of cassava meal had no specific effect (P>0.05) on carcass parameters. In conclusion, the simplified diet formulated with 80% of cassava by-products decreased the performance and carcass characteristics of rabbits (final carcass weight reduced by 10%).

Key words: *Manihot esculenta*, Growth performance, Rabbits, Carcass.

INTRODUCTION

The production rabbits has been increasing in several countries throughout the American continents because the productivity potential and meat characteristics quality. In this context, the feeding has been the most important component of production rabbit representing 70% of the costs.

Diets by non-ruminants are based on maize and soybean meal which increasing the costs of meat production because they are also used as the main components of the human industrial food (Silva *et al*., 2000). Consequently, the research on alternative ingredients for rabbit diets like cassava by-products are important for reducing the costs production. It is very important to evaluate the by-products of cassava industry as energy source and foliage hay as fiber source in rabbit diets.

Cassava products have been widely used during the last decade as animal feed. Abdel Baki *et al*. (1993) evaluated a complete and pelleted rabbit feed containing 45% of cassava products. The authors concluded that cassava products (roots and leaves) can be satisfactorily used as a partial substitute of the traditional energy and protein for growing rabbits. Scapinello *et al*. (1999) observed that the hay from the upper-third foliage of cassava had nutritional value similar to the alfalfa hay for rabbits.

Michelan (2004) have suggested that the digestive energy of maize meal can be replaced by cassava meal in diets for growing rabbits.

The present study was carried out to evaluate the animal performance from weaning to slaughtering and the carcass quantitative characteristics of rabbits using conventional or simplified diets in which cassava by-products represented 80% of the feed.

MATERIALS AND METHODS

Animals and experimental design

The experiment was carried out in the experimental rabbitry sector of the Maringá State University, Paraná, Brazil from May to July 2007 to evaluate the growth performance of New Zealand White rabbits (31 to 70 days old). The daily maximum and minimum temperatures during the study were 23 and 17ºC.

One hundred and forty-four weaned rabbits from does which were fed with control or simplified diets which were balanced with cassava meal from peeling roots which were obtained from floor wastes in the industrial processing line (Marques and Caldas Neto, 2002) and the upper-third of the plant foliage representing 80% of the diet (Table 1) and balanced for attending the requirements of reproductive animals (De Blas and Wiseman, 1998).

Weaning rabbits were allocated in iron cages following the factorial arrangement 2 x 3 (two diets for does and litters before weaning versus three diets from weaning to slaughtering) with 12 replications of two animals (one female and one male) per experimental unit. The control diet used after weaning was balanced with conventional ingredients for attending the nutritional requirements of growing rabbits and the others two simplified diets were formulated with the upper third of cassava foliage hay and ensiled or not ensiled cassava meal which represented 80% of the feed volume (Table 1).

The silage of cassava meal was carried out in plastic containers with the capacity of 200 kg after the addition of the thermofilic bacterial complex, amilolytic complex enzymes and the nutritive additive "Bacto Silo Katec®" for 30 days. Pelleted diets and water were offered *ad libitum.*

The animals were weighed at 31, 50, and 70 days and the daily feed intake, live weight, daily weight gain, feed:gain ratio and the carcass weight and slaughter yield were evaluated. The rabbits were slaughtered without fasting at 70 days. Measurements of carcass weight and yield were obtained with the hot carcass with the head but without lung, heart, liver, kidneys and other abdominal viscera. The weight and the dressing percentage were obtained for the hindleg, foreleg, loin, and thoracic-cervical.

Statistical Analysis

The following model was used in the statistical analysis:
$Y_{ijk} = \mu + M_i + G_j + MG_{ij} + e_{ijk}$, in which
Y_{ijk} = the performance and carcass characteristics of the k animal from does feeding of diet-i and diet-j in the growth period;
μ = general constant;
M_i = the effect of maternity-diet i, i = 1 and 2 and M_1 = control-diet and M_2 = simplified-diet with 80% of cassava by-products;

G_j = effect of the growth diet j in which j = 1, 2 and 3; G_1 = control-diet, G_2 = simplified-diet balanced with the upper-third foliage and cassava meal residue of industry no silage representing 80% of the feed volume, and G_3 = simplified-diet balanced with the upper-third foliage and cassava meal silage representing 80% of the feed volume;
MG_{ij} = Interactive effects of maternity-diets M_i and diets offered to the rabbits during the growth period G_j;
e_{ijk} = random error associated each observation.
Newman Keuls test or F test were used for the means comparisons ($P<0.05$).

Table 1: Ingredients and chemical compositions of the control and cassava maternity diets balanced with the upper-third foliage hay of cassava plants and cassava meal and the growing control and simplified balanced diets with the upper-third foliage hay and cassava meal ensiled or not

	Maternity diets		Growing diets		
	Control	Cassava	Control	Cassava	Cassava silage
Ingredients (%):					
Cassava upper-third foliage hay	-	40.86	-	41.60	41.60
Cassava meal	-	39.0	-	40	-
Cassava meal silage	-	-	-	-	40
Maize bran	25.81	-	28.44	-	-
Wheat bran	24.00	-	20	-	-
Alfalfa hay	16.65	-	17	-	-
Coast Cross hay	16.42	-	19	-	-
Soybean meal 45%	14.30	17.0	12.5	15	15
Di-calcium phosphate	0.50	1.4	0.8	1.45	1.45
Limestone	1.2	0.6	1.0	0.34	0.34
Common Salt	0.40	0.4	0.4	0.4	0.4
Min. and vit. premix[1]	0.50	0.5	0.5	0.5	0.5
Chemical composition based on feed nutrients (%)					
dl-Methionine 99	0.12	0.16	0.14	0.18	0.18
l-Lysine HCl 78	0.10	0.08	0.16	0.47	0.47
Crude protein	17	17	16	16	16
Methionine+ Cystine*.	0.6	0.6	0.6	0.6	0.6
Lysine*	0.8	0.8	0.8	0.8	0.8
Phosphorus	0.5	0.5	0.5	0.5	0.5
Calcium	1.0	1.0	1.0	1.0	1.0
Crude fiber	13	13	13,5	13,7	13,6
ADF	19	19.5	19	19.2	18.8
NDF	30	31	31	29.0	29.7
Digestive energy (kcal/kg)*	2600	2600	2500	2500	2500

[1]Nuvital, composition per kg: Vit A, 600.000 UI; Vit D. 100.000 UI; Vit E, 8.000 mg; Vit K3, 200 mg; Vit B1, 400 mg; Vit B2, 600 mg; Vit B6, 200 mg; Vit B12, 2.000 mcg; Pantothenic acid, 2.000 mg; Coline, 70.000 mg; Fe, 8.000 mg; Cu, 1.200 mg; Co, 200 mg; Manganese, 8.600 mg; Zinc, 12.000 mg; Iodine, 64 mg; Selenium, 16 mg; Methionine, 120.000 mg; Anti-oxidant, 20.000 mg. *Values based on nutrient tables (Rostagno, 2005)

RESULTS AND DISCUSSION

There were no interactive effects between maternity and growing diets for the parameters under study (Table 2). Rabbits from mothers which were fed with the maternity cassava diet had lower live weight (-23.6%) at the weaning time ($P<0.001$) than rabbits from mothers which were fed with the maternity control diet. The animals had lower live weight at 50 and 70 days but average daily growth was similar for the 2 groups whatever the period taken in consideration.

Although a reduced difference (-10.6% and -8.2%, respectively) was found for those rabbits which the mothers were fed with the control-diet, independently of the diets which were offered after the weaning. Theses results were caused by lower feed intake ($P<0.05$) observed for those animals. Similar results were reported by Abdel Baki *et al*. (1993) who showed that the daily gain of weight was lower with cassava products (30% of root meals and 15% of leaf meal) diets than with the commercial feed.

Probably, non-nutritional factors in the cassava by-products like tannin and hydrogen cyanide (HCN) may be affected the feed palatability and consequently reduced the feed intake. The hydrolysis of linamarin present in all parts of cassava plant produce hydrogen cyanide, a compound which is toxic for animals and man (Mazzuco and Bertol, 2000). The present results were consistent with the results reported by Michelan (2004). This author also reported lower feed intake when the cassava hay was included in the diets for growing rabbits.

Table 2: Means and standard error of rabbit performance born from does which were fed with control or cassava simplified diet and receiving, after weaning, the control or the simplified diets with cassava by-products ensiled or not

Parameters	Maternity diets		P	Growing diets			P
	Control	Cassava	values	Control	Cassava	Cassava silage	values
Live weight at 31 d (g)	758±8.4a	579±8.4b	0.001	671±10.4a	666±10.4a	669±10.4a	NS
Live weight at 50 d (g)	1527±22.5a	1365±22.5b	0.001	1533±27.6a	1386±27.6b	1419±27.6b	0.001
Live weight at 70 d (g)	2269±28.7a	2084±28.7b	0.001	2304±35.2a	2102±35.2b	2124±35.2b	0.001
Daily gain 31 to 50 d (g/d)	40.5±1.0a	41.4±1.0a	NS	45.4±1.2a	37.9±1.2b	39.5±1.2b	0.001
Daily gain 50 to 70 d (g/d)	37.1±0.8a	36.0±0.8a	NS	38.5±1.0a	35.8±1.0b	35.2±1.0b	0.05
Daily gain 31 to 70 d (g/d)	38.73±0.7a	38.60±0.7a	NS	41.87±0.8a	36.82±0.8b	37.30±0.8b	0.001
Feed intake from 31 to 50 d (g/d)	111±2.2a	104±2.2b	0.027	120±2.7a	105±2.7b	96±2.7c	0.001
Feed intake from 50 to 70 d (g/d)	138±2.2a	129±2.2b	0.007	153±2.7a	126±2.7b	120±2.7b	0.001
Feed intake from 31 to 70 d (g/d)	124±2.0a	117±2.0b	0.007	137±2.4a	116±2.4b	108±2.4c	0.001
Feed : gain from 31 to 50 d	2.76±0.05b	2.53±0.05a	0.001	2.68±0.06b	2.80±0.06b	2.46±0.06a	0.001
Feed : gain from 50 to 70 d	3.75±0.06a	3.60±0.06a	0.11	4.02±0.08b	3.56±0.08a	3.45±0.08a	0.001
Feed : gain from 31 to 70 d	3.22±0.03b	3.03±0.03a	0.001	3.28±0.04c	3.16±0.04b	2.92±0.04a	0.001

a-b Means in each line, for each variable, followed by different letters are significantly different (P<0.05) by F test for maternity diets effects and by Newman and Keuls test for growing diets effect

During the growth period, rabbits receiving the 2 experimental diets with cassava had the worse results for growth and feed intake (P<0.01) when compared to animals fed with the control diet. Nevertheless the feed:gain ratio was better (P<0.01) for animals receiving cassava diets, and particularly when they were fed on the cassava silage diet. The silage process improved the feed:gain ratio because there was a lower feed intake.

At slaughter, the performance results were reflecting the live weight and yield of carcass as well as part of them. The carcass parameters were better (P<0.05) for animals fed on control diet, except for hindlegs and forelegs proportions which were lower (P<0.05), and the loin yield which had similar (P>0.05) values (Table 3). The silage process of cassava meal had no effect (P>0.05) on carcass parameters when compared to not ensiled cassava use.

Table 3: Means and standard error of carcass parameters of rabbits from does which were fed with control or cassava diet and receiving, after weaning, the control diet and simplified diets with the cassava by-products silage or not

Carcass parameters	Maternity diets		P	Growing diets			P
	Control	Cassava	values	Control	Cassava	Cassava silage	values
Hot carcass weight (g)	1222±15.1a	1103±15.1b	0.001	1242±18.7a	1111±18.3b	1135±18.7b	0.001
Hindlegs weight (g)	393±4.6a	361±4.6b	0.001	398±5.7a	363±5.6b	369±5.7b	0.001
Loin weight (g)	284±4.4a	254±4.4b	0.001	290±5.5a	254±5.4b	264±5.5b	0.001
Forelegs weight (g)	136±1.7a	125±1.7b	0.001	136±2.0a	126±2.0b	130±2.0ab	0.002
Thoracic-cervical weight (g)	262±3.6a	232±3.6b	0.001	271±4.5a	234±4.4b	237±4.5b	0.001
Carcass yield (%)	53.3 9±0.3a	52.79±0.3a	0.11	53.78±0.3a	52.86±0.3b	52.62±0.3b	0.03
Hindlegs yield (%)	32.18±0.1b	32.80±0.1a	0.003	32.14±0.1b	32.73±0.1a	32.61±0.1ab	0.01
Loin yield (%)	23.14±0.2a	22.68±0.2a	0.18	23.28±0.3a	22.39±0.3a	23.07±0.3a	0.09
Forelegs yield (%)	11.21±0.07a	11.37±0.07a	0.09	11.02±0.08b	11.39±0.8a	11.46±0.08a	0.001
Thoracic-cervical yield (%)	21.42±0.1a	21.03±0.1b	0.03	21.76±0.2a	21.02±0.2b	20.90±0.2b	0.001

a-b Means in each line, for each variable, followed by different letters are significantly different (P<0.05) by the F test for motherhood diets effects and by Newman and Keuls test for fattening diets effects

CONCLUSIONS

The use of simplified diets with up to 80% of cassava by-products decreased both performance traits and carcass parameters. The silage process of the cassava meal from peeling roots which were obtained from floor wastes in the industrial processing line had no effect on the major parameters evaluated. Additional experiments are still required to determine the best level of cassava by-products in rabbit diets.

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