RABBIT BREEDING IN TROPICAL CONDITIONS, COMPARATIVE STUDY BETWEEN A LOCAL STRAIN AND AN EUROPEAN STRAIN : 2 / UTILISATION OF LOCAL CONCENTRATE OR OF IMPORTED PELLETED FEED IN FATTENING RABBITS

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Abstract - Two-day-old suckling rabbits of a selected strain (NZ) imported from a temperate country (France) were suckled in a tropical country (Benin) by does of the local strain (CECURI). The growth performance of the imported and native rabbits was compared after weaning at 31 days in a 8 weeks fattening trial. Four groups were constituted: 24 weanlings of each strain were fed either with the local feed (coarsely ground meal + green forage) or with an imported balanced pelleted diet. No morbidity was observed during the trial. NZ and CECURI rabbits had the same growth rate when fed with pelleted feed : 29.6 and 28.5 g/day respectively. This performance was only 10 to 22% lower than in temperate countries and the main reason was a lowered feed consumption in relation to temperature. The growth rate of CECURI rabbits fed on the local feed was lower than that of the group of the same strain fed on pelleted diet. The difference was only 18 % and mainly came from a lower dry matter intake (72.5 *vs* 84.7 g/day for pellets) The imported strain had difficulties of adaptation not to the climate but to the local feed. His growth rate was only 19.4 g/day *vs* 23.4 g/day for the local rabbits receiving the same feed. A potential effect of an early chemosensory experience (during both gestation and first suckling) of the imported strain is discussed.

INTRODUCTION

Most of the reports concerning raising of rabbit in hot climate reveal lower performance than in European countries.(OWEN, 1978). The most frequent explanation is the negative effect of temperature on feed intake (SAMOGGIA *et al.*, 1987; MARAI *et al.*, 1991). Nevertheless, very low growth rates are frequently observed with New Zealand White rabbits in different experiments conducted under tropical climates *i.e.* 12 to 14 g/day in Nigeria (SESE and BEREPUBO, 1996) or 8 to 10 g/day in India (CHAUDHARY *et al.*, 1995) and these very low performance cannot be related only to temperature.

At least four main reasons could explain these very low performance, separately or together:

- the climate (temperature + hygrometry + wind + etc...),
- the local conditions of management (equipment, professional knowledge, ...),
- the genetic potentialities of the rabbit strains employed, even if in quite all cases the rabbits are said to be « New Zealand White »
- and the quality of the feed employed, despite a gross composition in good accordance with recommendations

In order to analyse the relative contribution of some of these factors, we planed a trial in the rabbit breeding facilities of the *CEntre CUnicole de Recherche et d'Information* (CECURI) in Benin (Africa). The aim of the study was to compare with a factorial experimental design, the growth performance of the local African strain with an European selected strain using the local feed or an imported European balanced diet. A previous report (KPODEKON *et al.*, 1996) presented the pre-weaning part of the trial comparing, from 6 to 31days of age, the growth performance of young rabbits imported from France at 2 days, and of the native rabbits suckled by the same local does The present study compares the post weaning growth and feed consumption of the same rabbits given two types of feeds, one local and the other imported from France.

MATERIAL AND METHODS

Animals and Housing

Eighty young rabbits, born in Toulouse (France), were imported in Benin when 2 days old and then fostered by 27 does of the local strain (CEC) in the experimental unit of the CECURI.(Benin). The strain of the imported rabbits (INRA 1077 - issued from New Zealand White rabbits) was selected at the INRA Centre of Toulouse for reproduction traits (ROCHAMBEAU *et al.*, 1994). Each doe adopted 3 imported sucklings and kept 3 of her own progeny. Up to weaning, at the age of 31 days, the does and their litters were fed a concentrate coarsely ground and green forage in the form of palm tree leaves (Table 1). At weaning, 48 imported rabbits and 48 native rabbits were selected for the fattening experiment.
The experimental unit was open-sided, and equipped with wire mesh cages in flat deck (KPODEKON and COUDERT, 1993). Each cage had a metal feeder, and an automatic watering system. The weanlings were raised in a room different from that of the does. Hygienic prescriptions were strictly respected and prophylactic treatments wer regularly used against coccidia (ADEHAN *et al.*, 1992) and intestinal worms.

Feeding and drinking

The 2 types of feed studied were distributed *ad libitum.* and water was always available with automatic drinkers.
The local feed, called MEAL in the present paper, was constituted of the coarsely ground meal previously mentioned distributed with palm tree leaves. The meal was prepared in the CECURI experimental unit twice a week. The leaves were harvested 3 times a week and stored in a fresh building until utilisation.
The second diet was a commercial pelleted feed imported from France (INRA Toulouse) and labelled PEL in the following text (table. 2). To exclude any problem of conservation before the experiment, the necessary amount of the pelleted feed was transported by plane from Toulouse to Cotonou and arrived in the CECURI experimental unit just before the first utilisation, 10 days after manufacturing.

Table 1 : Ingredients and gross composition of the coarse meal concentrate employed in the CECURI unit and composition of the palm tree leaves (MEAL feeding)

List of ingredients of the Meal		Chemical composition (%)	Meal	Palm leaves
		- Dry matter	94.2	36.1
- Maize	14.0 %	*% Dry matter*		
- Wheat bran	50.0 %	- Minerals	7.6	5.8
- Brewer's grains	30.0 %	- Crude protein	18.7	16.0
- Soya meal	4.0%	- Crude fibre	10.1	37.5
- Oysters shells	1.6 %	- ADF	12.2	-
- Salt	0.4 %	- NDF	35.2	-
		- Ether extract	4.5	2.6

Table 2 : Ingredients and gross composition of the imported complete pelleted feed (PEL)

List of ingredients		Chemical composition (%)	
- Wheat	10.00 %	- Dry matter	87.8
- Barley	1.65 %	*% Dry matter*	
- Wheat bran	21.45 %	- Crude proteins	18.5
- Alfalfa dehydrated	34.98 %	- Crude fibre	17.2
- Sunflower meal	12.10 %	- ADF	20.5
- Spring smooth peas	4.00 %	- NDF	36.2
- Sunflower seeds	3.50 %	- Ether extract	4.6
- Wheat straw	4.80 %	- Minerals	10.3
- Cane molasses	5.00 %	- Calcium	1.8
- Minerals & Vitamins	2.52 %	- Phosphorus	0.7

Experimental design (Table 3)

Groups of animals - The 48 young of each strain (CEC or NZ) selected at weaning were randomly distributed in two groups, and immediately placed in wire mesh cages of 3 rabbits The first group was fed with the local feed and the second one with the imported pelleted feed.

Table 3.: Experimental design

		Local meal + forage (MEAL)	Imported pelleted feed (PEL)
Animals suckled by the same doe.	CECURI strain (CEC)	8 cages of 3 animals (CEC-MEAL)*	8 cages of 3 animals (CEC-PEL)*
	Imported strain (NZ)	8 cages of 3 animals (NZ-MEAL)*	8 cages of 3 animals (NZ-PEL)*

* names of the four groups in the text

An eventual maternal effect was controlled by using a balanced number of fostered and native rabbits suckled by the same doe. An eventual geographic effect of the situation of the cages in the fattening unit was controlled by distributing the cages into 8 blocs including the four groups.

Measured variables - Rabbits were weighed individually at 31 days and then every week until the age of 87 days.
The feed intake was measured on the cage basis in the following ways and calculated for each experimental week.

- Meal: the feeders were filled and weighed every day. The wasted meal was collected under each feeder and weighed. Then the daily consumption was calculated.
- Forage: fresh forage was weighed and distributed every day. On the following day the remaining forage was weighed and consumption calculated. There was no wasted forage. We took into account the spontaneous loss of weight of the forage due to desiccation.
- Pelleted feed : the feeders were filled and weighted every week. The wasted pelleted feed was collected and weighted and the consumption was calculated.

All results of feed intake and feed conversion ratio were expressed in dry matter.

Statistical analysis

The data study was made by variance analysis with the General Linear Procedure of the SAS-STAT package (SAS, 1988). The employed model included 3 factors (strain, type of feed and blocs) and the strain x feed interaction. When necessary, the means of the 4 experimental groups were compared with a t test on the basis of the least square means.

RESULTS AND DISCUSSION

Morbidity

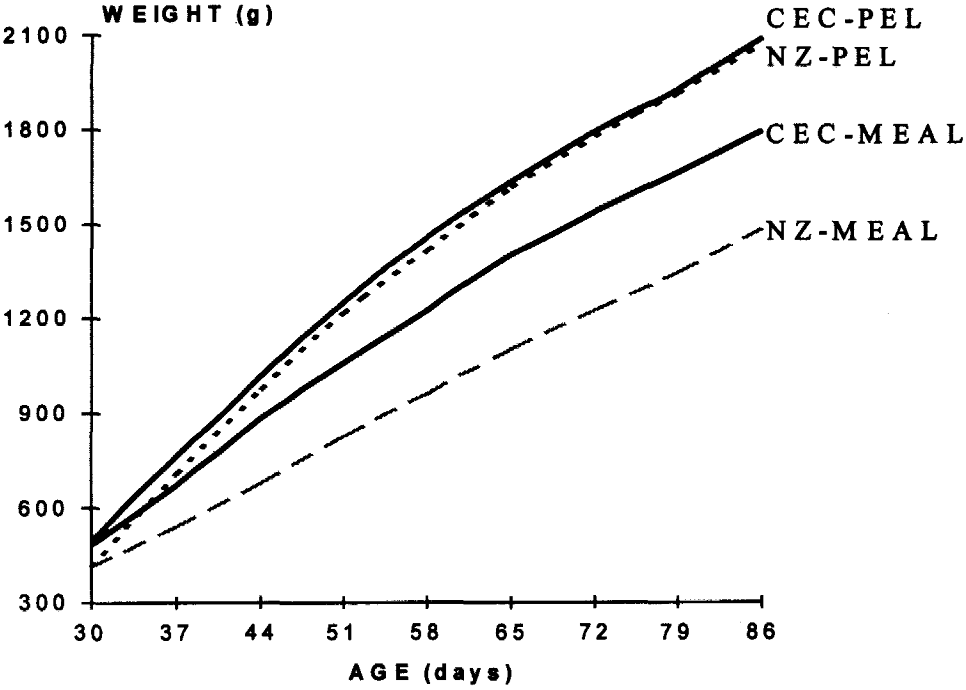
No disease occurred during this period. This situation is usual in CECURI during the whole dry season (November to April) (KPODEKON, 1988). Controls of coccidia were regularly done on faecal samples. The oocyst output was always low and no treatment was undergone. Two animals of group NZ-MEAL died (days 55 and 76) and two others of the same group were culled (broken leg). Then the results of this group were calculated on the basis of the 20 rabbits alive at the end of the experiment, after taking in account of the feed intake of the disappeared animals.

Weight and weight gain (Table 4 and Figure 1).

At the beginning of the experiment (day 31) imported animals had a significantly lower weight than the native ones. This was the consequence of differences in growth observed during the end of the suckling period as previously mentioned (KPODEKON *et al.*, 1996)

At the end of the experiment (day 87) the two groups fed on the imported pellets had a similar growth performance regardless of the strain. In addition the daily weight gain (DWG) was significantly higher in the PEL-fed group than in the two groups fed with the local feed (CEC-MEAL & NZ MEAL) (P<0.05).

Figure 1: Evolution of the weight of two strains of rabbits fed the two types of feed.



The growth of the two MEAL-fed groups was not similar. The NZ strain had a significantly lower DWG than the CEC strain (P<0.05). This lower DWG in group NZ-MEAL was especially pronounced just after weaning. During the first three weeks the average DWG of the NZ rabbits was 29% lower than that of the local rabbits (P<0.001). During the following 5 weeks, this difference lowered to only 7,6% on average and was not statistically significant.

Feed intake and Feed efficiency (Table 5).

With the meal, daily food wastage was very important and had represented up to 30% of the daily distribution. But as an appreciable quantity was remaining in the feeders every morning, the rabbits can be said effectively fed *ad libitum*. In addition, as the wasted meal was collected under the cages, the apparent consumption measured was very close to the real feed intake. With pellets, the wastage was quite negligible when compared to that observed with the meal.

During the whole experiment, the rabbits fed on the local feed ate an amount of palm tree leaves, independent of the rabbit's origin. But the imported rabbits ate a significantly lower amount (-35%) of meal (P<0.05) and this was observed during the whole experiment. Both groups fed on the imported pellets (CEC-PEL & NZ-PEL groups) consumed a similar amount of feed. The dry matter intake of these two groups was significantly higher than that observed for the two other groups fed on meal + forage (CEC-MEAL & NZ MEAL) (P<0.05).

On average for the whole experimental period, the dry mater feed conversion ratio (FCR) was the lowest for the imported rabbits (2.71 *vs* 3.04 - P<0.0001), without interaction with the source of feeding. On the contrary, the feed conversion ratio was similar with the 2 types of feeding (2.89 and 2.86 for the MEAL and PEL treatments respectively). Nevertheless it must be emphasised that during the first 3 weeks of the experiment, the FCR was significantly lower with the pelleted diet (1.81 *vs* 2.24) and that at the same time, no significant difference was observed between the types of rabbits. During the 5 following weeks, the situation was completely different and the lowest FCR was observed for the NZ-MEAL group alone : 2.93 *vs* 3.72 to 3.97 for the 3 other groups (P<0.001).

Table 4 : Growth performance of rabbits according to the strain and th

Groups * strain diet	No of rabbits	initial weight at 31 days (g)	Daily Weight Gain (g — 31 to 52 days	52 to 87 days
CEC MEAL	24	482 a	27.4 b	21.0 b
NZ MEAL	20	412 b	19.5 c	19.4 b
CEC PEL	24	494 a	36.1 a	23.9 a
NZ PEL	24	413 b	38.1 a	24.4 a
Residual Coef. of Variation (%)		*16.4*	*14.7*	*14.7*
Probability of Effects (P)	Strain	0.0001	0.0031	ns
	Diet	ns	0.0001	0.0001
	Strain x Diet	ns	0.0001	0.0829

a, b : in the same column, means with the same letter are not different at P = 0.05 ; ns = non significant (P > 0.10)
* CEC = local strain of the CECURI (Benin); NZ = imported strain of Toulouse (France); MEAL = local feed (CECU

Table 5 : Feed intake (g DM/day) and feed conversion ratio (FCR : g DM intake/g of gain) of fattening

Groups *		weeks 1 to 3				weeks 4 to 8			
		Dry Matter intake			FCR	Dry Matter intake			F
strain	diet	meal	forage	**meal+for.**, or *pelleted feed*		meal	forage	**meal+for.**, or *pelleted feed*	
CEC	MEAL	49,7 a	11,6 a	**61,3 a**	2,23 a	60,2 a	19,0 a	**79,2 b**	3,
NZ	MEAL	33,2 b	9,9 a	**43,2 b**	2,24 a	38,8 b	17,6 a	**56,4 c**	2,9
CEC	PEL			*68,0 a*	1,88 b			*94,7 a*	3,9
NZ	PEL			*66,1 a*	1,73 b			*90,7 a*	3,
Res.Coef.Var.		*17.2 %*	*16.4 %*	*11.0 %*	*7.7 %*	*12.8 %*	*16.7 %*	*8.6 %*	*8.*
Proba.	Strain	0.0075	ns	0.0006	ns	0.0009	ns	0.0001	0.0
Effects	Diet	-	-	0.0001	0.0001	-	-	0.0001	0.0
(P)	S. x D.	-	-	0.0042	ns	-	-	0.0014	0.0

a, b : in the same column, means with the same letter are not different at P = 0.05; ns = non significant (P >0.10)
* CEC = local strain of the CECURI (Benin); NZ = imported strain of Toulouse (France); MEAL = local feed (CECURI); PEL

GENERAL DISCUSSION AND CONCLUSION

The average daily growth rate observed in this experiment with feed and rabbits imported from France (29.6 g/day) are reduced by about 10% comparatively to the performance of rabbits of the same strain (INRA 1077) fed with similar diets in Toulouse during the summer time (33.2 d/day in summer and 38.2 g/day in spring ; LEBAS, 1996). As the minimum temperature observed in Toulouse was 20°C in the above mentioned experiment (with a maximum of 29°C) and as minimum temperature was higher in Benin (tropical climate during the dry season: daily minimum of 25-27°C), it can be assumed that the specific effect of climate and mainly of temperature represents a reduction of growth rate of 10 to 22% according to the European season considered as reference. The growth rate of the local rabbits was insignificantly lower than that of the rabbits imported from Toulouse. Then, the very low growth rates reported in the introduction of this paper *i.e.* 12-14 g/day in Nigeria, a country very near of Benin, (SESE and BEREPUBO, 1996) cannot be related to climate or rabbit strain since the climate was the same and rabbit of NZW origin in both cases. Then, the explanation must be searched in management conditions and/or feed quality, since the genetic and climate effects can be excluded as major factors.

The meal feeding employed in the present experiment induced a reduction of growth rate of 18% of the CECURI rabbits when compared to the imported pellets. This is the exact reduction of growth rate we observed some year ago in a meal *vs* pellets study of the same diets (29.7 vs 36.0 g/day) (LEBAS, 1973). Then we can exclude the effect of the feed presentation in the very low performance mentioned above. The remaining explanations are the feed composition (proportion and quality of the ingredients) and the management, but these explanations are only hypothesis.

More interesting is the unexpected low growth rate observed with the INRA1077 imported rabbits fed local meal + forage, nevertheless clearly higher than the very low growth rate mentioned in the introduction. It may be interpreted as an maladjustment of the imported rabbits to local feed. During the lactating period only the local feed was used. It was described (KPODEKON *et al* 1996) that the growth of both adopted and native sucklings was identical up to the third week. But during the fourth week, *i.e.* as soon as the sucklings began to consume the solid feed, the fostered rabbits (NZ) had a significantly lower growth. In the present work, we observed that the same animals after weaning fed with pelleted feed (NZ-PEL) had again the same growth than the local strain (CEC-PEL). Moreover, during the first weeks of fattening, the animals recovered their growth delay (Figure 1). Therefore the hypothesis of a genetic maladjustment of the imported strain to the African climate can to be discarded. On the contrary, the other group of imported animals fed with the local feed before and after weaning (NZ-MEAL) continued also to show a lower growth than the local strain. The feed efficiency being identical in both groups the only reason seems to be the lowered consumption of meal. The mortality observed during the experiment appeared only in the NZ-MEAL group. Two hypotheses can be suggested (KPODEKON *et al* 1996) to explain this lowered meal consumption in the imported rabbits. The first considered the possibility of a genetic inability to orally process the coarsely ground meal. The second hypothesis suggested the possibility of an effect of the early chemosensory (BILKO *et al*, 1994; HUDSON *et al*, 1994; SCHAAL *et al*, 1992). Indeed chemosensory experience gained both *in utero* and during the first day suckling period by the imported animals may have, at least partially, affected negatively the intake of the feed bearing an unfamiliar. If this hypothesis is correct, the present results (lasting 8 weeks) suggest stable consequences of early perinatal learning on postweaning feed consumption, and hence, on growth during the fattening period. This hypothesis will be tested in future trials.

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Élevage du lapin en zone tropicale, comparaison d'une souche locale avec une souche européenne; 2/ Utilisation d'un aliment concentré local ou de granulé importes, chez le lapin en engraissement - Des lapereaux de 2 jours provenant d'une souche sélectionnée (NZ) dans un pays tempéré (France) furent adoptés dans un pays à climat tropical (Bénin) par des mères d'une souche locale (CECURI). La croissance post sevrage des lapereaux importés et des lapereaux autochtones a été comparée dans un essai d'engraissement ayant duré 8 semaines. Au sevrage quatre groupes furent constitués: 24 lapereaux de chaque souche furent alimentés soit avec l'aliment local (farine grossièrement moulue + fourrage vert) soit avec un aliment granulé importé de Toulouse Aucun phénomène pathologique n'est survenu pendant l'expérimentation. Les lapins NZ et CECURI nourris avec l'aliment granulé ont eu les mêmes croissances : 29,6 et 28,5 g/jour respectivement. Celles-ci ne sont que 10 à 22% inférieures à celles obtenues en France avec des aliments de même type et la cause de cette diminution est essentiellement une sous consommation alimentaire en climat tropical. Les lapins de la souche CECURI nourris avec l'aliment local eut une croissance inférieure de 18% à celle des animaux de même souche nourris avec l'aliment granulé; cette différence provint principalement d'une consommation plus faible de farine : 72.5 vs 84,7 g/jour pour le granulé. Les lapins de la souche NZ eut des difficultés d'adaptation non pas au climat mais pour consommer la farine, il en est résulté une croissance plus faible : 18,4 vs 23,4 g/jour pour les lapins locaux recevant la même alimentation. Parmi les hypothèses évoquées, cette sous consommation pourrait être une conséquence à long terme de l'expérience chimiosensorielle acquise par les lapereaux NZ pendant la gestation ou lors de la première tétée.
