EFFECTS OF FEED RATIONING, FASTING AND A HERBAL SUPPLEMENT ON MORTALITY AND PERFORMANCE OF FATTENING RABBITS IN ERE CONDITIONS

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ABSTRACT

Rabbit breeders use a range of strategies in their attempt to minimise the digestive problems caused by ERE (Epizootic Rabbit Enteropathy). Feed rationing is one practice that effectively reduces health problems of a digestive nature. The aim of this article is to provide an overview of two studies conducted in ERE conditions. Restricted feeding was compared to *ad libitum* feeding. Some animals on a restricted intake were also subjected to a fast, and some of the ad libitum fed animals received Vegeplus, a plant-based supplement, added to their feed. Rabbits were fattened up in ERE conditions to the age of 67 days. They were weighed individually at 53 and 67 days and the consumption of each cage was determined at these same ages. Mortality was monitored daily. Some of the animals were necropsied at different points of the fattening, the diagnosis was death from digestive disorders, with most animals being diagnosed with ERE.

These studies in ERE conditions have shown the health benefits of feed restriction for fattening rabbits. Imposing a fast on animals already on restricted intake provides no additional health benefits, rather it severely penalises the growth performance of the rabbits. Although this technique is often practised by breeders who feed their animals *ad libitum*, it has less of a place in restricted intake techniques where the most effective way of imposing a fast has yet to be determined. Adding the natural plant extract Vegeplus to feed reduces mortality and improves production. When a health risk is present, the digestive security it provides reduces the need of feed restriction.

Key words: Rabbit– Epizootic Rabbit Enteropathy– Feeding management– Health status– Fattening performances

Introduction

Rabbit breeders use a range of strategies in their attempt to minimise the digestive problems caused by ERE (Epizootic Rabbit Enteropathy). Feed rationing is one practice that effectively reduces health problems of a digestive nature. Gidenne et al. (2008) have in fact shown that a 25% reduction in dietary intake leads to a significant fall in mortality of 46% (from 19.9% to 10.7%). In another article, he demonstrated that once intake is restricted by 20%, the benefits of rationing on mortality rates and health risks become significants (Gidenne et al., 2003). In an attempt to reduce the reliance on medical methods, research is now being conducted into different breeding techniques and natural products that could help improve the digestive health of young fattening rabbits. The aim of this article is to provide an overview of two studies conducted in ERE conditions at the In Vivo NSA Research Center (Vannes, FRANCE). Restricted feeding was compared to free feeding (*ad libitum*). Some animals on a restricted intake were also subjected to a fast in order to determine whether this strategy, which is sometimes found in the field, is yet better still for the health compared to traditional feed restriction. Finally, some of the ad libitum fed animals had Vegeplus, a plant-based supplement, added to their feed.

Material and method

Animals

For the first trial, 336 rabbits were allotted into groups upon weaning based on their weight at 31 days and litter. For the second trial, 384 young rabbits were allotted in the same manner. The animals were weaned at 32 days and housed in cages containing 8 rabbits each in a fattening unit at the In Vivo NSA Research Centre in Saint Nolff, which meets Good Laboratory Practice standards. For the first trial, a ninth rabbit was introduced into each cage at 33 days of age and inoculated with 500 µl TEC4, then removed at 47 days old.

For the second trial, all animals were inoculated with 50 µl TEC4. TEC4 is an inoculum manufactured by INRA and used to reproduce ERE in test conditions via the oral inoculation of rabbits. The rabbits were fattened up to the age of 67 days. They were weighed individually at 53

and 67 days and the consumption of each cage was determined at these same ages. Mortality was monitored daily.

Treatment

Both trials involved a comparison of four groups. The **AL** group of rabbits was fed *ad libitum*. The **R** group was rationed at 75% of theoretical intake. The **R+Fast** group received the same ration as the R group, but a 48-hour fast was imposed after the second death in this group. These three groups were fed on the same commercial fattening diet. The **AL+Vegeplus** group was fed *ad libitum*. The feed given to this group was a diet similar to that given to the other three groups but with the addition of Vegeplus, a natural plant-based product.

Statistical analysis

The mortality data were compared using a Chi-squared test. The growth data were compared using analysis of variance for a linear model. For each endpoint, the trial effect, the treatment effect and their interaction were studied.

Results

Health status

The mortality results are given in Table 1. The incidence of animal deaths observed in each of the groups differed to a statistically significant degree (P=0.00062). The mortality rate in the AL group was 12.5%. Feed restriction reduced mortality by 63%, since only 4.7% of the animals in the R group died. The 48-hour fast was imposed during the first two weeks of fattening. The rationed animals that had undergone the fast presented a mortality rate of 9.7%, this figure lying between that of the rationed animals and that of the animals that were fed *ad libitum* on the same feed. Imposing a fast on already rationed animals does not therefore seem to achieve any health improvements compared to traditional feed restriction. The results show that with free feeding, adding Vegeplus to the feed produces a very significant improvement in the health status of the

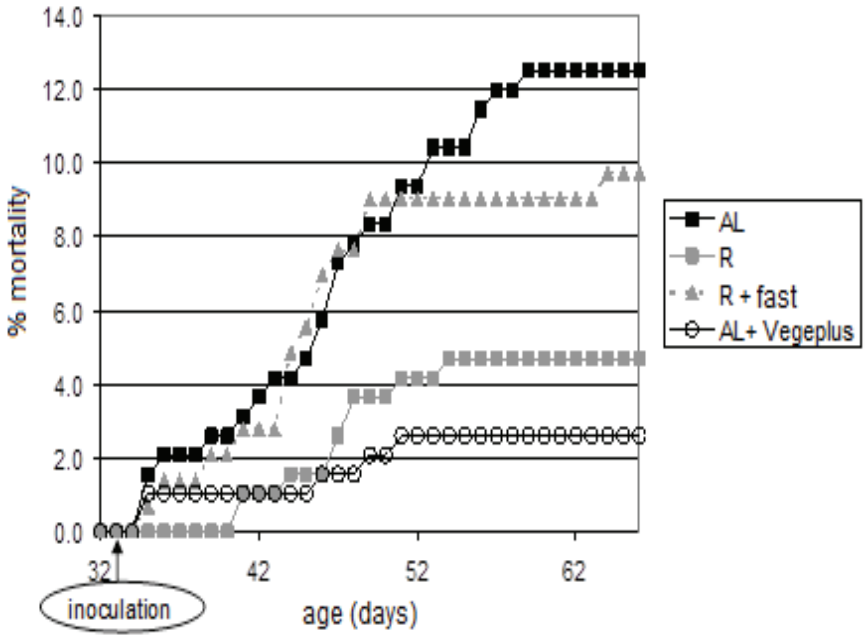
animals. In fact, mortality was 79% lower in the AL+Vegeplus group than in the AL group, with only 2.6% of the Vegeplus animals having died in ERE conditions.

Some of the animals were necropsied at different points of the fattening, all groups combined. The diagnosis was death from digestive disorders, with most animals being diagnosed with ERE.

	AL	R	R+Fast	AL+Vegeplus	P. Chi²
initial number	192	192	144	192	**0.00062**
mortality rate %	**12.5 c**	**4.7 ab**	**9.7 bc**	**2.6 a**	

Table 1: Cumulative mortality at the end of the fattening period

Graph 1 shows the change in mortality throughout the fattening period. Mortality peaked at 40 days i.e. approximately one week post-inoculation.



Graph 1: Change in cumulative mortality during the fattening period, by group

Body weight and growth

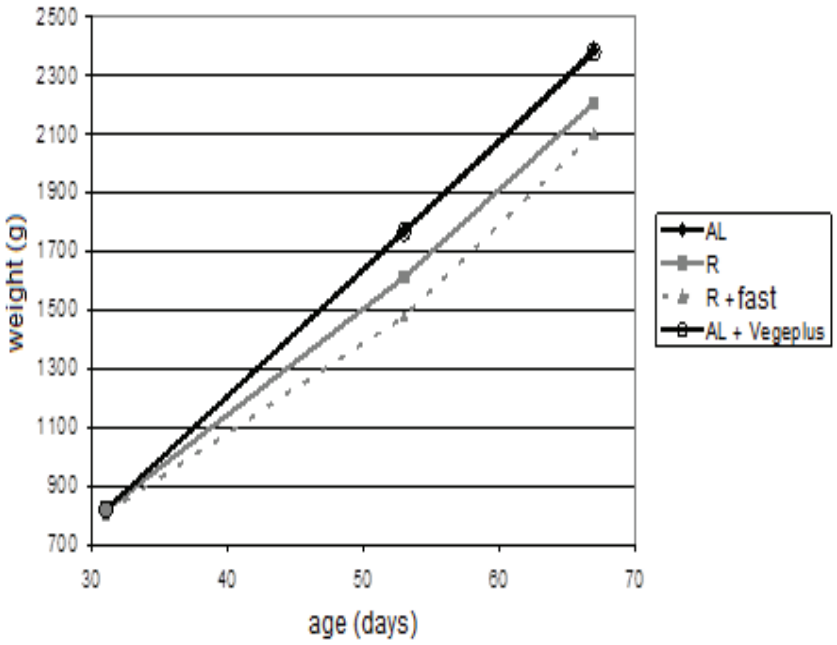
The body weight and ADG (Average Daily Gain) results are given in Table 2. The body weight and ADG figures are from the surviving animals and provide good morbidity indicators.

	Body weight (g)			ADG (g/day)		
	31 days	**53 days**	**67 days**	**31-53 days**	**53-67 days**	**31-67 days**
AL	818 (+/-72)	1,768 a (+/-184)	2,385 a (+/-182)	43.2 a (+/-6.5)	45.3 a (+/-7.6)	44.0 a (+/-4.3)
R	818 (+/-71)	1,611 b (+/-103)	2,205b (+/-133)	35.8 b (+/-3.9)	44.0 a (+/-4.5)	38.9 b (+/-3.2)
R+Fast	805 (+/-69)	1,477 c (+/-139)	2,101 c (+/-171)	30.7 c (+/-5.0)	47.0 b (+/-4.7)	36.6 c (+/-4.0)
AL+Vegeplus	819 (+/-73)	1,764 a (+/-166)	2,378 a (+/-187)	43.3 a (+/-5.3)	46.1 a (+/-5.9)	44.1 a (+/-4.3)
P trial	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	NS
P treatment	NS	<0.0001	<0.0001	<0.0001	0.0002	<0.0001
P trial *treatment	NS	0.0074	NS	NS	<0.0001	NS

NS: Not significant at the 5% level, mean (+/- standard deviation)

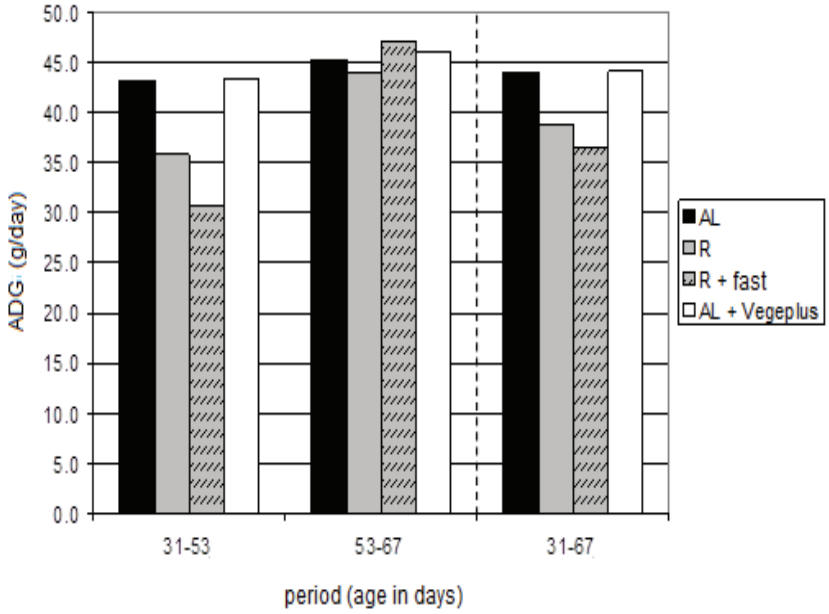
Table 2: Growth performance, by group

Free feeding resulted in a significantly higher body weight at the end of the fattening period than restricted feeding (P<0.0001). The average weight of the animals at 67 days was 2,835 g in the AL group compared to 2,205 g in the R group i.e. 180 g higher (Graph 2). This meant an average growth of 5.1 g/day i.e. 13.1% higher between days 31-67 (P<0.0001) (Graph 3). Imposing a fast between days 32 and 53 caused a significant fall in body weight of 137 g on average at 53 days, compared to the rationed group (P<0.0001), with the resulting impact of an average loss of 104 g in body weight at 67 days (P<0.001). The animals in the R+Fast group therefore never recovered from the growth retardation caused by the fasting. Throughout the fattening period, this growth retardation meant a fall in ADG of 2.3 g/day (P<0.0001) i.e. 5.9% between days 32 and 67 compared with the R group. Finally, adding Vegeplus to the feed of fattening rabbits in ERE conditions produced animals whose growth and weight at slaughter are comparable to those of the AL group (2,378 g vs. 2,385 g at 67 days).



Graph 2: Change in average weight between days 32 and 67, by group

The significant crossover observed in weight at 53 days is due to the fact that for trial 1, the AL group weighed 25 g more than the AL+Vegeplus group, whereas it weighed 23 g less for trial 2.



Graph 3: Change in ADG during the fattening period, by group

Feed intake and feed conversion ratio (FCR)

The intake and FCR figures are taken from the zootechnical study of the living animals. Intake and FCR, accounting for dead animals, is discussed in another chapter.

The intake of the R group was 16% lower than the AL group ($P<0.0001$) over the whole of the fattening period (Table 3), resulting in a significant improvement in FCR of 0.11 points over this same period ($P<0.0001$). The ERE-induced morbidity resulted in a fall in intake by the freely-fed animals compared to what would be expected in their healthy counterparts. Therefore, the rabbits in group R consumed only 16% less than the animals in group AL and not 25% less. The 25% intake restriction we applied was, in fact, calculated based on the theoretical intake of animals fed *ad libitum* in good health conditions.

Imposing the fast meant an average reduction of 8.9 g/day (9.6%) in feed intake between days 32 and 53 compared to the rationed group ($P<0.0001$). This fall in post-weaning consumption had significant repercussions on the whole of the fattening period ($P<0.0001$), since the animals who

had fasted during the initial period never compensated for this during the second period. The animals in the AL+Vegeplus group consumed more than those in the AL group over the whole fattening period (140.6 g/day vs. 132.0 g/day; P<0.0001) and their feed conversion ratio was not as good (3.21 vs. 3.01; P<0.0001), probably due to the low mortality rate observed in this group and the morbidity observed in all animals.

	intake (g/day)			feed conversion ratio		
	32-53 days	**53-67 days**	**32-67 days**	**32-53 days**	**53-67 days**	**32-67 days**
AL	107.3 b (+/-9.1)	170.8 a (+/-30.3)	132.0 b (+/-11.9)	2.55 a (+/-0.15)	3.68 b (+/-0.57)	3.01 b (+/-0.22)
R	92.8 c (+/-2.4)	140.2 b (+/-5.3)	111.4 c (+/-2.5)	2.66 b (+/-0.11)	3.22 a (+/-0.26)	2.90 a (+/-0.07)
R+Fast	83.9 d (+/-2.2)	138.6 b (+/-3.7)	105.2 d (+/-2.5)	2.78 c (+/-0.26)	3.00 a (+/-0.19)	2.92 a (+/-0.15)
AL+Vegeplus	116.8 a (+/-9.0)	177.8 a (+/-9.7)	140.6 a (+/-8.3)	2.75 c (+/-0.19)	3.90 c (+/-0.25)	3.21 c (+/-0.12)
P trial	NS	NS	NS	<0.0001	0.01	NS
P treatment	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P trial *treatment	NS	NS	NS	0.0037	NS	NS

mean (+/- standard deviation)

Table 3: Feed intake and consumption intake results, by group

Economic analysis

Table 4 gives the economic analysis for the four trial groups. The results have been extrapolated in order to estimate performance figures for 1,000 weaned rabbits. Revenue has been calculated based on slaughter weight at 67 days and a price of €1.85 kg/body weight (source: RENACEB/RENALAP 2012, published by ITAVI).Feed expenditure has been calculated based on the total feed consumed (including by the rabbits that died during the fattening period). The cost of the feed was taken from the 2012 figures published by ITAVI in its RENACEB/RENALAP report i.e. €277/tonne. The economic analysis provides an overview of the zootechnical results and the mortality results, looking at the animals as a whole, including those that died during fattening.

For 1,000 weaned rabbits	AL	R	R+Fast	AL+Vegeplus
Weaned number	1,000	1,000	1,000	1,000
Slaughtered number	875	953	903	974
Total weaned weight (kg)	817	817	804	817
Total slaughtered weight (kg) *(base 100)*	2,062 *100*	2,086 *101*	1,882 *91*	2,302 *112*
Weight gain (kg) **(A)**	1245	1270	1078	1485
Total feed intake (kg) **(B)**	4,252	3,792	3,374	4,856
FCR **(B/A)** *(base 100)*	3.41 *100*	2.99 *88*	3.13 *92*	3.27 *96*
Revenue (€) **(C)**	3,753	3,797	3,425	4,190
Revenue (base 100)	*100*	*101*	*91*	*112*
Feed expenditure (€) **(D)**	1,178	1,050	935	1,466
Feed expenditure (base 100)	*100*	*89*	*79*	*124*
IOFC/1,000 weaned rabbits (€) **(C-D)**	2,575	2,747	2,490	2,724
IOFC (base 100)	*100*	*107*	*97*	*106*

Table 4: Economic comparison of the four test methods

The AL group had the lowest slaughter number, and the AL+Vegeplus group had the highest (875 animals slaughtered vs. 974). Total slaughtered weight, extrapolated to 1,000 weaned

rabbits, ranged from 1,882 kg for the R+Fast group to 2,302 kg in the AL+Vegeplus group. Of the various feeding methods used, the R+Fast group had the lowest feed intake. The animals in this group consumed 11% less than the R group, 21% less than the AL group and 31% less than the AL+Vegeplus group. The feed conversion ratio represents the ratio between the total weight gain between weaning and slaughter, and total intake, including the feed consumed by the animals that died during the fattening period. The feed restriction method resulted in the lowest FCR (3.13), whilst the AL group had the least efficient FCR (3.41). Our economic simulation shows that breeders wishing to maximise their revenue should use the AL+Vegeplus method. This is because it allows the most rabbits to be slaughtered at a good weight. Revenue was 12% higher for the AL+Vegeplus group than for the AL group, with the R group generating a revenue similar to that of the AL group. The R+Fast group generated the lowest revenue, 9% less than the AL group. Thanks to its lower feed cost and lower mortality rate, the R group gave an Income Over Feed Cost (IOFC) that was 7% higher than the AL group. Fasting the rationed animals reduced the IOFC, not only compared to traditional rationing but also compared to free feeding (-3%). Finally, despite the additional cost, adding Vegeplus to the feed of animals fed *ad libitum* resulted in an increase in IOFC with a 6% financial gain compared to free feeding, due to the lower mortality rate in the AL+Vegeplus group.

Discussion

These results confirm the benefits of restricting feed to 75% of theoretical intake in order to minimise the health problems of ERE in test conditions. This initial observation, along with the necropsy diagnoses, lead us to conclude that the method for reproducing ERE in test conditions as used at the In Vivo NSA Research Station (St Nolff, FRANCE) is valid.

The feed restriction method achieved a 49% drop in mortality during the fattening period in these conditions.

However, imposing a fast on the animals on top of the feed restriction did not produce any improvement in the animals' health if imposed following the second death. This strategy is sometimes used in practice to restore digestive balance. Nevertheless, we found that fasting does

not carry any additional benefits compared to feed restriction alone. Not only were no health benefits observed, but this practice has a clear negative impact on the growth of the animals, reducing weight at 67 days by 104 g compared to the animals on restricted feeding but no fast. It may initially appear that a 48-hour fast is too long. Shortening it to 24 hours may limit the negative effects on growth. The fasting technique may also be more effective with freely fed animals. However, since fewer and fewer breeders are using this technique, it was not included in our study. It would nevertheless be interesting to compare this practice in free feeding and restricted feeding conditions in order to determine the conditions in which it may be most effective. In fact, if this technique is being used in practice by breeders who feed their animals *ad libitum* during the fattening period, could it still pose benefits for breeders who practice restricted feeding?

The immune system needs nutrients such as certain amino acids in order to function and ensure the synthesis of the proteins involved in immune defence. If the body cannot obtain the necessary amino acids from its food intake, they are produced from muscular catabolism (Le Floc'h et al., 2004). Stopping the feed of rabbits when they become ill can therefore weaken the animal and slow down the immune defence mechanism.

Finally, adding Vegeplus to freely-provided feed guarantees the fattening process from a health standpoint by significantly limiting mortality in ERE conditions compared to a Control feed. The mortality rate of the animals fed *ad libitum* but including a Vegeplus supplement was numerically less than that of the animals on restricted feed. Therefore, in ERE conditions, Vegeplus provides health protection equivalent to a restricted diet, whilst at the same time allowing free feeding which provides better growth. Vegeplus is a natural product made from plant extracts and is therefore consistent with current attempts to reduce the use of antibiotics in the rabbit husbandry sector.

Conclusion

These two studies in ERE conditions have shown the health benefits of feed restriction for fattening rabbits. Imposing a fast on animals already on restricted intake provides no additional health benefits, rather it severely penalises the growth performance of the rabbits. Although this technique is often practised by breeders who feed their animals *ad libitum*, it has less of a place in restricted intake techniques where the most effective way of imposing a fast has yet to be determined. Adding the natural plant extract Vegeplus to feed improves production even when a health risk is present since the digestive security it provides means the need for feed restriction is lessened.

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