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GAINING WEIGHT RESPONSE TO RESTRICTED FEEDING BY TWO RABBIT GENETIC GROUPS

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Abstract

To study weekly changes in rabbits growth rate, feed restriction as a proportion of commercial feed commonly provided to growing rabbits in Mexico valley's region, was used. The experiment was carried out at the Rabbit Research and Teaching Farm of the Colegio de Postgraduados, at Chapingo, Mexico. There were two periods (Phase 1 and 2; three weeks each) with a complete block design with four repetitions and a 2 x 3 factorial arrangement of treatments: two genetic groups (pure Chinchilla and F1 Chinchilla x New Zealand White) with 36 rabbits (7 to 13 weeks of age) each; and three feeding programs: TT, control where rabbits received 100 g (wk 1), 120 g (wk 2), 130 g (wk 3), 150 g (wk 4-6); RL, 80% intake of TT (Phase 1), then intake 20% above TT (Phase 2); LR, intake 20% above TT (Phase 1), then 80% intake of TT (Phase 2). Blocks were average initial live weight (g): block I= 990 ± 40; II= 1135 ± 38; III= 1260 ± 38; IV= 1390 ± 40. Criteria measured were weekly body weight and feed intake; variables calculated and analysed were average daily feed intake, average daily gain (ADG), and feed conversion. Analysis of variance was done to detect main effects of factors and, in order to monitor weekly trends of the variables, an split-plot analysis was performed, where feeding programas were considered as main plots and weeks, within each phase, as split-plot. Results indicate an erratic trend of weekly ADG which ranged between 20 to 40 g; a high of 50 g was found the week when rabbits were changed from restricted to ad libitum, which was considered as a compensatory growth response. There were no differences (P>.05) between genetic groups. These results indicate that an 80% restriction does not reduce variability on weekly ADG, but perhaps enhances it. Mortality percentage was 13.9% on the whole, with a larger deaths number toward the hibrid group; however, this was not significant (Chi-square P>.10).

Introduction

Feed restriction has been imposed in rabbits in order to obtain a more efficient production (Lebas, 1975; Lebas and Laplace, 1980 and 1982; Parigi-Bani et al., 1978; Fekete and Gipert, 1981; Ledin, 1984, cited by Szendro et al., 1989; De Blas, 1984). Even though feed restriction is commonly practiced to avoid overweight in does, it has not been well defined for growing rabbits. As clearly pointed out by Szendro et al. (1989), results obtained so far cannot be applied since body weight and gain in

growing rabbits are highly variable. Therefore, the objective of a practical feed restriction program in growing rabbits should be the control of the changing pattern in weekly weight gain. In general, post-weaning ADG varies between 20 to 40 g using a pelletized diet (minimum, 17% crude protein, 11% crude fiber, 2.5% crude fat) and this is true for the México valley's production systems. Some experiments (unpublished data) run at the Rabbit Research Farm of the Colegio de Postgraduados (Chapingo, México), have shown that a one week high ADG is followed by a decline (5 to 15 g) during the next one or two weeks. Then a second high ADG, is found, usually lower than the first one, beginning the cicle again until the rabbits have reached market weight. Also, the amount of feed consumed shows some variation through time. Thus the weanling rabbits keep growing during the fattening period, but usually weekly rate differ.
This research is a first approach about the effect of restricted feeding on the variability of weekly weight gain under the hypothesis that feed restriction will stimulate a more regular relation among feed intake and live weight gain measured on weekly basis.

Materials and Methods

Two genetic groups, (1) pure breed Chinchilla, and (2) Chinchilla x New Zealand White hybrid, with 36 rabbits each (age 7-13 wk) were used during two periods (Phase 1 and 2; three weeks each) to study three feeding programs: TT, control (ad libitum); RL, 80% intake of TT (Phase 1), then intake 20% above TT (Phase 2); LR, was the reversal situation to RL. Daily feed amount given each week is shown in Table 1; feed used was a pelletized commercial ration.

Table 1. Feeding program (g)

Phase 1 (week)			Phase 2 (week)		
Program	1	2	3	4	5	6
RL	80	96	104	180	180	180
TT (Control)	100	120	130	150	150	150
LR	120	144	156	120	120	120

Experimental unit was each cage (three rabbits/cage); due to availability problems with the research facilities, rabbits were 7 wk old, which was 2 weeks after weaning. Therefore, for this trial, rabbits age ranged between 7 to 13 weeks. The design was a complete randomized block with a 2 x 3 factorial treatment arrangement; four blocks stratified the initial animal average live weight (g): block I, 990 ± 40; the other three were: 1135 ± 38; 1260 ± 38; and 1390 ± 40, correspondingly. The initial three weeks, Phase 1, represents a typical growing period in rabbits; meawhile the following three, Phase 2, represents a stage where the animals approaches puberty and the rate of growth declines; the switching of treatments from Phase 1 to Phase 2 was intended to compensate the possible under-nutrition caused by the RL treatment and to reduce any possible over feeding or spillage from the LR.

The research facilities limitations, made impossible to undertake a more suitable experimental design as the ones proposed by Lucas (1956, cited by Martínez-Garza, 1988) which combines the principles of reversal design and balanced uncomplete blocks. However, the design used permited to carry out analysis of variance to test the factors efect on treatments, for each phase, and the possible performance chages on growing related variabales through weeks along the experimental phases; this last analysis was a proper for a split-plot design in each phase, within genetic group; feeding programs were identified as main plots and weeks as the split-plot.

Live weight (individual's cage average) and feed intake (whole experimental unit) were taken every week. Feed consumption, average daily gain, and feed conversion were the analysed variables; treatment means were compared by the Tukey's procedure. The cases of death were registered along the weeks, taking into account the genetic group and the feeding program. contingency chi-square tests were used for mortality.

Results and Discussion

Table 2 shows the summarized analysis of variance for the 2 x 3 factorial. It is evident that Phase 1 and Phase 2 are practically two different experiments, where the former could have a carry over effect on the second, a possibility not tested on this study. In Phase 1 (7 to 10 weeks of age) it was detected a superior effect of the LR program (P<.01) related to the ADG,

feed intake. There were no differences for the feed conversion variable.
The Phase 2 (11 to 13 weeks of age) results document differences for feed consumption between genetic groups (P<.01), corresponding to the hybrid CH x NZ the higher feed intake value; among the feeding programs, the RL treatment was the highest for consumption (P< .01). The coefficients of variation (CV) for the analysis in Phase 1 were less than 10 % , in contrast to those in Phase 2 which ranged between 10 % (feed intake) to 21% (ADG and feed conversion).

The means for the studied variable are presented in Table 3. A very surprizing case was related to feed intake: the consumption was far low than expected; considering the data from Table 1 (feed offered), feed restriction in Phase 1 (RL) might indeed be the minimum normal amount to be supplied to these kind of animals. However, the detection of a different ADG between feeding programs

(P<.01) where RL is lower than TT and LR, makes a point about the "convenience" to provide an extra amount of feed, say no more than 15%, to that minimum (93 g + 14g) to somehow stimulate the growing rate. A further complication related to this point was the presence of a significant interaction (P<.05) for genetic group 2 with feeding programs, where LR was the lowest.

The Phase 2 means for feed intake show the pattern of compsution for the two genetic groups. It' is evident that the CH x NZ group ate the higher amount with an overal value of 130 g against 110 g for the pure breed Chinchilla. Once again, the consumption was lower then the expected, and the genetic group-feeding program interaction was documented by the CH x NZ group with LR. Given the switching strategy with feeding programs, the hybrid behaves as expected: the RL program showed the highest consumption; however, no differences were detected for ADG, even thought a higher value was obtained by it in the hybrid group (34.4 ± 3.4 g), meanwhile the LR program effects on ADG was at least equal to the control (TT).

The Feed Conversion results show nothing but the ordinary ratio values for rabbits at the ages studied: about 3 units of feed required per unit of weight gain during acelerated growth, and 4 - 4.5 to 1 in pubers. To this study, no matter which group or program was analysed, the ratio Feed/Gain was the same within each phase. It might mean that any difference in feed consumption was overcome by a corresponding difference in weight gain.

Mortality was not related to any factor in the experiment, even though a suspicion association is shown with the hybrid CH x NZ, where mortality was higher (19.4%, average) than the one for Chinchilla (8.3%). The proper Chi-square tests were applied, given probabilities for higher values as the one calculated, largers than 10%. A remarkable point is the fact that the RL program for Phase 2, which implies a sudden increase of feed supply, did not exhibit any animal dead during its occurrence. This particular results show no indicious of any enterotoxemia induced by over-eating after a feed restriction period, as the one cited by Robinson, et al. (1988), who found undesirable the combination restriction-ad libitum feeding for very young growing rabbits.

The second approach to monitor the growth's weekly variation in weanling rabbits was documented with the split-plot analysis. Tables 4 to 6 show the mean and standard deviation values. In general, the performance of the two genetic groups follows a similar pattern for ADG; there were differences (P<.01) for weeks in Phase 2 ; the ADG was higher for the fourth week with about 40 g against less than 30 g for the other two weeks; the RL program reached almost 50 g during this forth week. A possible compensatory growth might be exibited by animals which were under the 80 % feed restiction program and suddenly exposed to ad-libitum feeding. At the same time, it is very dicouraging that after that ADG peak of almost 50 g, the rate of gain declined the next week as quikly as it grew.

With regard to feed intake, the Chinchilla exhibited differences (P<.01) only during Phase 1, corresponding the highest value to the LR trait as itwas expected; to the other hand, the hybrid group showed a moderately difference (P<.05) only during Phase 2, corresponding the higher values to RL and TT programs, as expected. Related to the feed conversion, the Chinchilla group showed no differences, while the hybrid group exhibited a better conversion (P<.01) for the first week during Phase 2.

A close look to the ADG's means evidence that the strategy followed for feed restriction has no effect in reducing the variability of the weekly growing rate. The up and down in the ADG figures is quite evident in any of the genetic group, for any of the feeding programs, TT included. The results in this study corroborate the erratic behavior for the gaining weight in rabbits during the fattening period and probably getting worse when they are reaching puberty.

Further experimentation must be done on these topics taking into consideration the ones made by Szendro et al. (1989) about the convenience of restricting feeding time instead of feed proportios ; blocking (stratifying) initial live weights of contemporary litter-mates of weaned rabbits it may be a sound procedure if someone prosecutes experimentation on feed restriction and compensatory growth. The data in this study, besides other non published yet, there was documented off the records that lighter same-age animals gain as much as the havier during a given period of time, and frequently with a lower feed conversion. It is also convinient to say that for this study the results might be affected by the reduced number of experimental animals.

References

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Table 2. Analysis of variance, different traits, by phases.

Trait source	d.f.	Phase 1 MS	F	Phase 2 MS	F
Feed intake					
(A) Genetic group	1	132.95	<1	40 361.14	12.82**
(B) Feeding program	2	1 930.67	2.09	17 700.57	5.62*
(AB) Interaction	2	5 704.38	6.19*	19 322.29	6.14*
(E) Error	15	921.35		3 149.46	
(CV) Coeficient of variation		7.03%		10.18%	
Average daily gain					
A	1	16.35	2.09	81.22	2.11
B	2	54.58	6.99**	30.77	<1
AB	2	9.03	1.16	30.75	<1
E	15	7.81		38.56	
CV		8.56%		21.67%	
Feed conversion					
A	1	.211	2.51	.090	<1
B	2	.132	1.57	.016	<1
AB	2	.060	<1	1.67	2.26
E	15	.084		.737	
CV		9.85%		19.81%	

*,** statistical differences at 5% and 1%, respectively.

Table 3. Means and standard deviations for traits by Phases, trough-out the factorial arrangement of treatments.

Trait	Genetic group	Feeding program	Phase 1	Phase 2	Whole experimental period
Feed intake g/d	1	RL	87.7± 5.9	116.1±15.0	101.9± 9.4
		TT	92.6± 8.9	100.4±14.3	96.5± 5.3
		LR	103.8± 5.7	117.2± 7.7	110.5± 3.6
	2	RL	92.9±11.5	147.9±20.6	120.4±15.0
		TT	98.8± 9.5	129.1± 6.3	114.0± 4.0
		LR	89.3±14.9*	110.4± 3.4	99.9± 9.0
*Interaction: unexpected reduction in feed intake for LR					
Average daily gain (g)	1	RL	29.0± 2.0	27.4± 4.8	28.2± 2.2
		TT	31.2± 4.9	28.0± 5.7	29.7± 4.6
		LR	35.2± 2.9	25.1± 4.0	30.3± 3.3
	2	RL	30.6± 4.2	34.4± 3.4	32.0± 2.7
		TT	35.0± 2.1	27.3± 6.5	30.5± 4.7
		LR	34.8± 2.4	29.7±10.5	32.1± 5.7
Feed/gain	1	RL	3.08± .16	4.28± .57	3.48± .18
		TT	3.03± .27	3.78±1.3	3.22± .66
		LR	3.00± .32	4.75± .77	3.56± .43
	2	RL	3.05± .19	4.30± .48	3.58± .31
		TT	2.87± .44	4.86± .80	3.56± .43
		LR	2.62± .60	4.01±1.2	3.08± .72
Mortality %	1	RL	0	0	0
		TT	0	16.7	16.7
		LR	0	8.3	8.3
	2	RL	25.0	0	25.0
		TT	8.3	0	8.3
		LR	25.0	0	25.0

Table 4. Feed intake on daily basis for weeks, analysed by genetic group.

Genetic group	Trait	Phase 1			Phase 2		
		1	2	3	4	5	6
1	RL	77± 2.7	92± 2.2	94±15.6	110±22.1	137±15.9	103±30.4
	TT	90± 4.8	94±10.3	90±12.6	103±13.2	109±18.6	89±22.8
	LR	97±13.0	108± 6.3	107± 8.3	120± 5.2	111±11.9	118± 7.4
2	RL	78± 1.5	102±22.4	99±13.6	104±13.2	147±23.8	156±33.6
	TT	89±13.5	108± 2.5	103±11.7	131±18.4	137±10.8	129±13.1
	LR	90±16.7	95± 8.5	79±19.4	90±30.5	120± 1.0	120±25.4

Note: Group 1, phase 1, differences (P<.01): RL and week are the lowest group 2, phase 2, differences (P<.05): LR is the lowest.

Table 5. Average daily gain, analysed by genetic group.

Genetic group	Trait	Phase 1			Phase 2		
		1	2	3	4	5	6
1	RL	28.7± 3.1	34.9± 2.7	23.4±11.7	48.2± 6.4	18.8± 9.3	15.1± 8.1
	TT	35.8± 4.8	28.8± 6.8	27.9±14.9	33.9±18.8	28.9± 2.3	21.1± 6.6
	LR	38.7± 3.3	31.1± 3.6	34.6± 5.7	24.6± 3.5	24.1± 6.0	26.6±10.9
2	RL	31.7± 5.6	37.3± 9.6	22.7±14.4	46.2± 5.8	34.2± 6.4	24.4± 6.5
	TT	39.7± 1.8	30.3± 3.4	33.9± 4.3	38.0± 3.7	25.0±13.6	19.0± 3.8
	LR	36.2± 4.2	29.3± 9.6	38.8± 4.1	35.0±10.6	25.4± 4.6	28.8±25.3

Note:Group 1 and 2, phase 1, no statistical differences; phase 2, differences (P<.01) for weeks: week 1 the highest.

Table 6. Feed over gain by weeks, analysed by genetic group.

Genetic group	Trait	Phase 1			Phase 2		
		1	2	3	4	5	6
1	RL	2.72± .29	2.64± .23	5.44± 3.9	2.35± .81	8.88± 5.0	8.04± 3.4
	TT	2.56± .37	3.41± .83	5.19± 4.7	4.06±2.90	3.99± .94	4.45± 1.5
	LR	2.50± .34	3.52± .52	3.12± .33	5.07± .90	4.85± 1.5	5.0 ± 1.8
2	RL	2.53±.46	2.73± .59	5.56± 2.82	3.05± .33	4.32± .18	6.72± 1.92
	TT	2.26±.42	3.49± .58	3.08± .61	3.22± .37	6.55± 3.04	6.94± 1.13
	LR	2.47±.26	3.77±1.70	2.16± .74	2.87±1.40	4.83± .91	5.56± 2.24

Note: The only difference (P<.01) was for weeks in phase 2, within groups: fourth week the lowest.