

EFFECT OF REDUCTION OF EATING TIME ON PRODUCTION OF GROWING RABBITS

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Introduction

The ad libitum feeding is widely applied both under large scale and small farming rabbit breeding conditions. As a consequence of the favourable experiences in other animal species, studies on the application of restricted feeding have been initiated also in rabbit breeding (Lebas, 1975; Lebas and Laplace, 1980 and 1982; Parigi-Bini et al., 1978; Fekete and Gippert, 1981; Ledin, 1984). The results obtained in the experiments usually can not be repeated under practical conditions, since the body weight and body weight gain of the growing rabbits, and consequently their feed requirement, is strongly variable. There are for example growing rabbits of either 0.5 or 1.5 kg body weight at 6 weeks of age, thus the feed restriction suggested for 1 kg body weight will result in starvation in the case of those rabbits of 1.5 kg body weight, and in ad libitum feeding for those with 0.5 kg body weight. It is a problem, at the same time, that the distribution of the daily rations is laborious and inaccurate. Instead of restricted feeding we have expected the favourable effect of reducing the eating time. In this system all individuals have access to feed for the same, restricted period of time, to eat their daily feed requirements.

Material and methods

The three related experiments have been carried out at the rabbit unit of the Research Center for Animal Breeding and Nutrition, using New Zealand

White growing rabbits weaned at 35 and 28 days of age. Three rabbits have been housed in each crate in experiment 1, and the rabbits were kept individually in experiments 2 and 3. Litter-mate rabbits were divided into the experimental groups that way that initial body weights and sex ratios were equalized. All individuals received the same amounts of pellet of identical composition. At the end of the feeding period the feeders were closed, and opened again next morning. Drinking water was available ad libitum from nipple drinkers. Body weight and feed consumption were registered weekly, the amount of wasted pellet continuously. In experiment 3 the daily rhythm of feed intake have been registered in every 0.5, 1 and 2 hours, at 6, 8, 10 and 12 weeks of age, and ethological observations were carried out at 12 weeks of age (in each minute, on the basis of the behavioural pattern characteristic to the given minute - only in the feeding period). Digestibility trials were carried out on New Zealand White rabbit groups (4 adult female per group) with various feeding periods (4, 8, 10 and 12 hours, by day and night) compared to the control group fed ad libitum. The investigations were carried out with the method of Fekete and Gibbert (1982).

Results

In experiment 1., beside the control group (eating continuously), groups eating 1, 2, 4, 8, 16 and fasting 23, 22, 20, 16, 8 hours, respectively, daily were tested. After 5 days the experiments were terminated, since rabbits of the control group and those ones which have eaten 16 hours daily gained 30.4 and 28.9 g daily and 18.9, 12.2 and 16.2 daily weight losses were observed in groups, 1, 2 and 3, respectively. Only those rabbits gained 8 g/day which were eating 8 hours daily (Fig. 1.).

It was characteristic to the eating activity that even the rabbits eating 1 hour daily, rested quietly following a 15 to 20 minutes greedily feed intake.

In experiment 2., beside the control group, five other groups were formed: eating 8 or 12 hours during the day, eating 12 hours during night, eating 16 hours daily, and fasting once for 24 hours weekly. In each group 30 rabbits, weaned at 5 weeks of age, were involved. On the basis of the production figures (Table 1.) the conclusions are as it follows:

- Even the individuals eating 8 hours daily and showing poor figures were able, toward the end of the experiment, to attain average daily gain figures similar to those of the control group.
- Body weight gain of the groups fastened 24 hours per week, was by 10 % less than that of the control group.
- Growing rabbits require 12 hours or less, but more than 8 hours, daily to eat their feedstuff requirements.

Experiment 3., was designed on the basis of the former data. Beside the later mentioned groups eating 9 to 12 hours daily, an additional group was formed, where the eating time was reduced, parallel to the increase of age.

C = control group eating continuously (for 24 hours)

12 = group eating between 07 and 19 o'clock and fasting between 19 and 07 o'clock

11 = group eating between 08 and 19 o'clock and fasting between 19 and 08 o'clock

10 = group eating between 09 and 19 o'clock and fasting between 19 and 09 o'clock

9 = group eating between 10 and 19 o'clock and fasting between 19 and 10 o'clock

V = group eating 12, 11, 10 and 9 hours daily between 6 to 8, 8 to 10 and 10 to 12 weeks, respectively.

Production results obtained during the study are summarized in Table 2.

Average daily weight gain during fattening (4 to 12 weeks) was slightly reduced with decreasing eating time. Rabbits in group eating 12 hours daily - similarly to experiment 2. - gained slightly more than those in the control group, but individuals eating 9 and 10 hours gained by 2 to 4 % less than the controls or those eating 12 hours daily. These differences, however, did not prove to be significant.

Feed intake of the experimental groups between weeks 4 and 12 decreased more than the average daily gain, due to the reduction of eating time. Rabbits in the control group consumed by 6 to 15 % more feed than those fed restricted. Feed consumption of the control group was significantly higher in each fattening period, with the exception of group eating 12

hours daily, between weeks 8 and 12. It comes from the weight gain and feed intake figures of the groups that feed conversion was the poorest in the control group and the best in group eating 9 hours daily. The experimental groups were better by 7.3 to 12.5 % ($P < .0,01$) than the control group.

The small size of the experimental groups does not allow us to analyze the mortality figures to a great extent, but the observed tendencies give us some information.

According to the results, during the most critical period (3rd week) after weaning, the lowest mortality figures were obtained in the group eating 12 hours daily and in the group where eating time was changing. These groups achieved figures better than the controls or identical to them, also between weeks 4 to 10, but more rabbits became sick and were lost when the eating time was reduced too much.

The most important behavioural characteristics are shown in Table 3.

The rabbits adapted themselves to the shorter eating time by increased hourly feed consumption. Amount of feed consumed hourly was increased by 2 to 2.5 times, as compared to the controls, when the eating time was reduced and age increased. The hourly feed intake changes also during the day, the consumption peaks were around 07 and 19 o'clock. The hourly eating time was 4.4 minutes in the control group and was increased by 2 to 2.5 times in the group fed restricted. There was no difference among the group in respect of eating speed. The time spent on eating at each occasion was also only slightly different. The number of feed intakes per one hour was by 2 to 3 times higher than in the control group.

It is clear from the comparison of the behavioural patterns that 8.4 % and 16.5 to 20.5 % eating times have been observed in the control and experimental groups, respectively, and the time spent on drinking was 2.3 % and 4.1 to 4.6 %, respectively. Individuals in the experimental groups could increase the eating and drinking times only at the expense of washing and moving. Time spent on resting was nearly identical in all groups. The digestibility coefficients are shown on the Table 4. The best results could be achieved by the group fed in the period of 4 hours/day, but the group fed 8 hours was also significantly superior to the control group fed ad libitum. In the groups fed 10 and 12 hours/day significant improvements could only be detected for the digestibility of crude protein. No significant differences were found for the other coefficients.

Conclusion

It can be observed from the experiments that the rabbits eating less than 24 hours can also consume the amounts of feed required daily, which is rendered by the significant change of their behaviour. By limiting the eating time, the hourly number of feed intakes and the eating time increase, and consequently also the amount of feed consumed hourly. The increase is 2 to 2,5-fold.

The older rabbits can eat more in a unit of time than the young ones. Therefore the eating period can be limited not only to a constant period of time (e.g. 12 hours), but it can be further reduced by advancing age (see group eating for changing times).

The hourly feed intake was periodically changing during the day, the peak consumptions were observed at 07 and 19 o'clock, respectively. This gives reason for the testing of feedings limited to the morning and evening periods.

The economic importance of the restricted (in time) feeding first of all is that the average daily feed intake is reduced by 6 to 15 % and feed conversion is improved by 7 to 13 %, and at the same time, the average daily gain is practically unchanged. Because of the continuous changes in the digestibility coefficients of the young animals only the adult rabbits could be investigated. In spite of this fact, the differences between the needs for maintenance and for the body weight gain of the young rabbits could be neglected. Therefore, based on the results of the digestibility trials it is not possible to settle whether the decreased daily feed consumption could be balanced by the higher digestibility coefficients. It could only be stated that the higher feed conversion rate of the rabbits with limited feeding may be attributed partially to the higher digestibility of the feedstuffs.

On the basis of our experiments we can recommend to test or to apply the eating times restricted to 12 hours daily or reduced from 12 hours to 9 hours between ages of 4 to 12 weeks.

Summary

In a series of experiments, with restricting daily eating times from 1 to 16 hours, the effects of one weekly fasting day were tested in New Zealand White growing rabbits. The experimental animals increase the hourly num-

ber and time of the feed intakes by 2 to 2.5 times, thus are able to eat the daily feed requirements in 9 to 12 hours. Having identical body weight gain figures, they consume by 6 to 15 % less feed and their feed conversion is improved by 7 to 13 %, as compared to the controls. On the basis of the experiments, testing or using under field conditions the eating times restricted to 12 hours daily or reduced from 12 hours to 9 hours between ages of 4 to 12 weeks, can be recommended.

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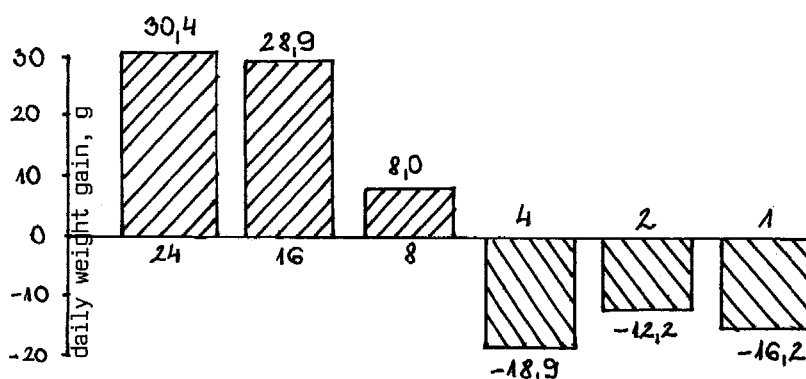


Fig. 1. Effect of daily eating time on daily weight gain

Table 1.

Production figures of New Zealand White growing rabbits eating continuously or for a restricted period of time

Age Weeks	Daily eating time (hours)					
	Control 24	1 day fasting weekly	16 16 - 8	12 during day 8 - 20	12 during night 20 - 8	8 8 - 16
	Daily average gain (g)					
5 - 6	29.0	28.1	29.5	34.1	34.2	20.6
6 - 7	29.3	24.6	23.8	29.7	29.1	20.3
7 - 8	32.8	28.3	33.8	32.8	32.7	20.5
8 - 9	30.2	26.6	33.9	29.6	30.4	30.3
9 - 10	31.3	23.3	28.1	32.0	30.3	20.3
10 - 11	23.0	-	32.7	34.4	22.3	30.9
5 - 11	29.3	26.2	30.3	32.1	29.8	23.8
	Feed conversion					
5 - 6	2.04	2.14	1.83	1.90	1.77	2.28
6 - 7	2.46	2.71	2.42	2.38	2.39	2.35
7 - 8	2.70	2.80	2.56	2.60	2.66	2.97
8 - 9	2.97	3.11	2.72	3.07	3.01	2.31
9 - 10	3.66	4.53	3.73	3.59	3.65	4.69
10 - 11	3.84	-	3.32	3.21	4.40	2.80
5 - 11	2.92	-	2.77	2.79	2.98	2.86

Table 2.

Production figures of New Zealand White growing rabbits eating continuously or for a restricted period of time

Age Weeks	Daily eating time (hours)					
	24 n=23	12 n=28	11 n=21	10 n=21	9 n=20	Changing n=21
4 - 5	36.0	32.7	28.8	28.7	25.6	31.2
5 - 6	39.9	35.2	40.3	36.5	34.3	38.7
6 - 7	36.3	37.5	40.6	39.5	37.1	42.0
7 - 8	38.1	34.3	31.2	29.5	30.3	32.5
8 - 9	30.3	36.5	35.2	31.9	36.5	31.2
9 - 10	33.3	34.7	28.0	33.6	35.6	33.9
10 - 11	27.7	29.2	28.0	31.1	34.4	27.6
11 - 12	24.0	29.9	29.0	27.9	26.4	27.0
4 - 12	33.17	33.75	32.64	32.32	32.54	33.01
Average daily gain (g)						
4 - 5	57.6	53.9	49.2	48.5	45.4	51.0
5 - 6	80.2	70.8	73.5	70.8	64.1	73.9
6 - 7	100.8	95.3	96.1	93.0	84.6	98.2
7 - 8	125.9	113.6	108.2	105.9	96.4	113.6
8 - 9	119.2	115.2	115.0	105.7	105.9	106.5
9 - 10	128.3	120.2	111.6	112.9	110.9	113.5
10 - 11	131.6	122.3	115.0	118.7	117.8	113.8
11 - 12	126.8	130.2	126.3	122.8	123.6	120.5
4 - 12	108.79	102.66 ^{xx}	99.35 ^{xx}	97.28 ^{xxx}	93.67 ^{xxx}	98.86 ^{xx}
Daily feed consumption (g)						
4 - 5	1.60	1.65	1.71	1.69	1.77	1.63
5 - 6	2.01	2.01	1.82	1.91	1.87	1.91
6 - 7	2.78	2.54	2.37	2.36	2.28	2.33
7 - 8	3.31	3.31	3.46	3.59	3.18	3.50
8 - 9	3.94	3.15	3.27	3.31	2.90	3.42
9 - 10	3.85	3.46	3.99	3.36	3.11	3.35
10 - 11	4.75	4.19	4.10	3.82	3.42	4.12
11 - 12	5.29	4.35 ^{xxx}	4.36 ^{xxx}	4.40 ^{xxx}	4.68 ^{xxx}	4.46 ^{xxx}
4 - 12	3.28	3.04 ^{xxx}	3.04 ^{xxx}	3.01 ^{xxx}	2.87 ^{xxx}	2.99 ^{xxx}
Feed conversion						
6 - 7 (pieces)	6	1	3	4	5	2
4 - 10 (%)	22.0	14.6	26.8	26.8	29.3	22.0
Mortality after weaning						

Notes: Significantly different from control

^xP < 0.05, ^{xx}P < 0.01, ^{xxx}P < 0.001

Table 3.

Pattern of behavioural characteristics of growing rabbits depending on the length of daily eating period

Items	Daily eating time (hours)				
	24	12	11	10	9
	Hourly feed consumption (g)				
at 6 weeks of age	4.0	6.8	7.5	7.5	7.6
at 8 weeks of age	5.6	10.0	10.4	11.0	12.0
at 10 weeks of age	6.3	10.6	9.7	12.3	12.4
at 12 weeks of age	5.7	11.4	13.0	12.9	15.7
	Eating behaviour				
Time spent on eating hourly (minutes)	4.4	9.5	10.7	7.8	10.5
Eating occasions hourly	1.3	3.1	2.8	2.9	3.8
Time spent on eating at each occasion (minutes)	3.4	3.1	3.8	2.7	2.8
Eating speed g/minute	1.2	1.1	1.1	1.4	1.4
	Behavioural patterns				
Eating (%)	8.4	18.6	20.6	16.6	19.2
Drinking (%)	2.3	4.6	4.4	4.1	4.1
Cleaning (washing) (%)	16.0	15.1	13.1	10.9	8.5
Mouving (%)	8.7	6.1	2.4	2.2	4.7
Resting (%)	64.6	55.6	59.5	66.2	63.2

Table 4.

Effect of reduction of daily eating period on digestibility
coefficients
(n = 4)

Daily eating period		Dry matter	Organic matter	Crude protein	Crude fiber	N.F.E.
24 hours	\bar{x}	64.54	65.77	64.45	27.63	77.17
(control)	s	1.68	1.54	1.74	2.49	1.03
	CV%	2.61	2.34	2.70	9.01	1.34
12 hours	\bar{x}	64.02	66.18	66.43 ^x	28.09	77.19
(at day)	s	1.31	1.35	1.63	2.68	1.64
8-20	CV%	2.05	2.03	2.30	9.54	2.12
12 hours	\bar{x}	65.22	66.60	66.51 ^x	27.14	77.15
(at night)	s	2.26	1.92	1.51	4.16	1.38
20-8	CV%	3.46	2.88	2.27	15.33	1.78
10 hours	\bar{x}	65.07	66.37	67.39 ^x	28.58	78.84
8-18	s	1.11	1.06	1.06	2.08	1.07
	CV%	1.71	1.60	1.58	7.28	1.36
8 hours	\bar{x}	67.30 ^x	68.80 ^x	69.09 ^x	37.24 ^x	78.74 ^x
8-16	s	1.39	1.28	1.65	2.84	1.16
	CV%	2.07	1.68	2.39	8.77	1.47
4 hours	\bar{x}	72.48 ^x	73.67 ^x	74.38 ^x	41.95	82.22 ^x
8-12	s	3.30	3.05	2.44	6.73	2.22
	CV%	4.56	4.14	3.27	16.04	2.70

^xSignificantly different from control P < 0.05

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In a series of experiments, with restricting daily eating times from 1 to 16 hours, the effects of one weekly fasting day were tested in New Zealand White growing rabbits. The experimental animals increase the hourly number and time of the feed intakes by 2 to 2,5 times, thus are able to eat the daily feed requirements in 9 to 12 hours. Having identical body weight gain figures, they consume by 6 to 15 % less feed and their feed conversion is improved by 7 to 13 %, as compared to the controls. On the basis of the experiments, testing or using under field conditions the eating times restricted to 12 hours daily or reduced from 12 hours to 9 hours between ages of 4 to 12 weeks, can be recommended.

EINFLUSS DER VERMINDERUNG DER TAGLICHEN FRESSZEIT AUF DIE PRODUKTION BEI JUNGEN KANINCHEN

Verfasser untersuchten den Einfluss der Fresszeit von 1 bis 16 Stunden pro Tag und den Einfluss der Fastenzeit auf die Produktion der Jungtiere der Neuseeländer Weiss Kaninchen Rasse, im Alter von 4 bis 12 Wochen. Bei einer Fresszeit von 9-12 Stunden erhöhte sich die Frequenz der Futteraufnahme und die verabreichte Futtermenge auf das Doppelte oder mehr. Im Vergleich zur Kontrollgruppe (Fresszeit 9-12 Stunden/Tag) verminderte sich die tägliche Futteraufnahme um etwa 6-15 Prozent, die Verdaulichkeit - bei gleicher Massenzunahme - um 7-13 Prozent erhöhte sich. Aufgrund der Forschungsergebnissen schlagen die Verfasser die Reduzierung der täglichen Fresszeit auf 12 Stunden pro Tag oder eine Verminderung von 4 Stunden in je 2 Wochen ab Entwöhnung (also von 12 auf 9 Stunden) vor.

