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EFFECT OF DIFFERENT FEED RESTRICTIONS DURING REARING ON REPRODUCTION PERFORMANCE IN RABBIT DOES

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ABSTRACT : *Ad libitum* fed ten-week-old littermate female NZW rabbits were divided into four equal groups (n=4 x 50) based on their body weight. They were raised during the next 7 to 12 weeks as follows: a control group with *ad libitum* feeding (C); access to a restricted 130 g daily feed portion per head until 17 weeks of age and 140 g/day until first insemination (130R); one day (24 hours) fasting every week (1D); 9 hours' daily access to the diet (9H). When the young does reached 75 to 80% of adult weight (3.4 to 3.5 kg, between 17 and 22 wk of age), the feed supply returned to *ad libitum* four days before the first AI, resulting in a 4-day flushing in the 3 treated groups. The does were reinseminated 9-11 days *post partum* and three consecutive deliveries were investigated. Fertility was significantly higher in nulliparous 1D group (92%) than in the control (70%). Litter size at birth, at 21 and at 35 days of age in groups 130R (8.8, 7.6, 7.3) and 9H (8.9, 8.3, 8.2) while at the same age litter weights of 130R (502 g, 2760 g, 6295 g) and 9H does (543 g, 2848 g, 6761 g) were insignificantly higher than for C ones (8.7, 7.3, 7.0 and 472 g, 2451 g and 6032 g, resp.). The lowest litter size and litter weight of 1D females could be explained by their smallest body weight throughout the trial. Among the four groups, the 130R females lost less weight at kindling and they were the heaviest during the lactation period. In general, it was concluded that raising young rabbits with restricted 130 g diet per day or with access of 9 hours' daily feeding time resulted in doe performances that neither decreased nor improved significantly.

RÉSUMÉ: Effet de différentes restrictions alimentaires pendant l'élevage sur les performances ultérieures de reproduction des lapines
Des lapines NZW âgées de 10 semaines, jusque-là nourries *ad libitum*, ont été divisées en quatre groupes égaux (n = 4 x 50) selon leur poids vif. Durant les 7 à 12 semaines suivantes elles ont reçu : une alimentation *ad libitum* pour le groupe témoin (C) , une ration journalière réduite à 130 g par animal jusqu'à l'âge de 17 semaines puis 140 g/jour jusqu'à la première insémination (130R) , un jeûne d'une journée (24 heures) par semaine (1D) , ou un accès libre l'aliment pendant 9 heures par jour (9H). Quand les jeunes lapines ont atteint 75 à 80 % de leur poids adulte (3,4 à 3,5 kg c'est à dire entre 17 et 22 semaines d'âge selon les lots) l'aliment a été distribué *ad libitum* pendant 4 jours avant l'insémination, ce qui équivaut à un « flushing » de 4 jours pour les 3 groupes expérimentaux. Les lapines ont été ré-inséminées 9-11 jours *post partum* et trois mises bas consécutives ont été suivies. Le taux de mise bas a été significativement plus élevé pour les lapines nullipares du groupe 1D (92 %) que pour celles du groupe témoin (70%). La taille de la portée à la naissance, à 21 et 35 jours pour les groupes 130R (8,8 - 7,6 -7,3) et 9H (8,9 - 8,3 - 8,2), et au même âge, le poids des portées des lapines du groupe 130R (502 - 2760 - 6295 g) et 9H (543 - 2848 - 6761 g) n'ont été significativement différents des valeurs observées dans le groupe témoin C (8,7 - 7,3 - 7,0 et 472 - 2451 et 6032 g, respectivement). La taille et le poids de la portée plus faibles chez les femelles du groupe 1D peuvent être expliqués par un poids vif inférieur tout au long de l'expérimentation. Parmi les lapines des quatre groupes, celles du groupe 130R ont perdu le moins de poids à la mise bas et sont restées les plus lourdes pendant la lactation. En conclusion, pour les 3 premières portées, les performances des lapines ne sont pas significativement modifiées lorsque les jeunes lapines sont soumises à une alimentation réduite à 130g/jour ou ont un accès à l'aliment autorisé seulement pendant 9 heures/24h.

INTRODUCTION

The prolificacy and lifetime performance of rabbit does are partly determined by their body condition (CIFRE *et al.*, 1994; FORTUN-LAMOTHE, 1997). Rabbits for meat production generally reach 50 to 55 per cent of their adult weight by 9 to 10 weeks of age. The females become sexually mature by the age of 3.5 to 4 months, although it is advisable to wait a half or one additional month before their first breeding. However, the breeds with rapid growth are prone to be overfed during this last four-week period, which may lead to lower fertility and, as a consequence, poorer prolificacy. Overfat does at first kindling are more sensitive to dietary fluctuations. A reduction of intake after the first parturition can create a quick emaciation of these does, causing higher frequency of disease problems (LE ROUX *et al.*, 1998). Thus, to obtain a breeding flock with adequate body condition, it is suggested that the growth of young rabbits should be restricted by limiting their feed supply during the growing period. Reduction of energy intake by limiting feeding time is also recommended in the case of fat adults and after weaning (TAG EL DEN *et al.*, 1988).

Ad libitum fed, early-bred rabbits (first insemination at 75 to 80 per cent of adult weight) show high conception rates at their first breeding. For a longer productive lifetime and lower mortality loss MAERTENS (1992 and 1995) suggests, when a reproduction diet of >2500 Kcal/kg is given, restricting the feeding of the young replacement does to 35 g/day/kg live weight until the 17th or 18th week and postponing the time of first breeding until the 18th week of age with 4 days of flushing before the first insemination. In the case of *ad libitum* feeding, he

recommends providing a fattening diet of lower energy content (2350-2400 Kcal/kg).

The objective of our investigation was to compare does' reproductive performance depending on whether feeding was *ad libitum* or restricted with respect to quantity or time during their growth between 10 weeks of age and 4 days before their first AI.

MATERIALS AND METHODS

The NZW rabbits were housed individually in wire-net flat deck cages, in a closed building illuminated through windows and supplementary artificial light (8D:16L). At 10 weeks of age, the *ad libitum* fed females (n=200) were allocated to four equal groups, based on their 10-week live weight and litter size at birth. Littermates were allotted into different groups. The diet was available *ad libitum* or restricted until reaching their breeding weight of 3.4 to 3.5 kg (i.e. until 17 to 22 weeks of age):

Feed restriction methods :

Group **C** :	*ad libitum* feeding (control)
Group **130R** :	130 g daily feed portion until 17 week of age and 140 g/day after that
Group **1D** :	one day (24 hours) each week with no access to the diet but free water intake
Group **9H** :	9 hours (11.00 to 20.00 h) daily access to feed; water intake allowed at any time

The does and their progeny received the same pelleted diet (90% dry matter, 17.5% crude protein, 3.05% crude fat, 13.9% crude fibre, 10.3 MJ/kg digestible energy). Drinking water was freely available from valved self-drinkers. The limiting of feeding time was achieved by turning the feeder round.

Does were bred after reaching 75 to 80% of adult weight (3.4 to 3.5 kg). Four days before the first AI feeding was returned to *ad libitum* in all groups resulting in flushing of treated animals. Between November and March, the females were reinseminated on the 9th to 11th day *post partum* and three consecutive deliveries were investigated. Empty does (checked by palpation 10 to 14 days after insemination) were re-inseminated 28 days after the previous AI. Pooled fresh semen was used and a dose of 1.5 µg GnRH analogue hormone (Ovurelin, Reanal, Hungary) was administered to induce ovulation. In the case of litters larger than ten, pups were fostered within the same group after birth. Females were allowed to nurse freely. Offspring were weaned at 35 days of age.

The *statistical analysis* was carried out according to the GLM procedure using STATGRAPHICS version 6.0 software. The analysis of significance of the distributions was performed by means of chi-square test. The influence of group and parity on traits was tested on individual data through fixed effect variance analysis according to the following model:

$$Y_{ijk} = \mu + F_i + P_j + FP_{ij} + e_{ijk}$$

Where

Y_{ijk} the litter or individual observed
μ overall mean
F_i effect of feeding method (C, 130R, 1D, 9H)
P_j parity effect (1,2,3)
FP_{ij} effect of the interaction feeding method by parity
e_{ijk} residual random error

Feed intake was not individually measured but its values were calculated from group averages so these data were not statistically evaluated.

Does that remained open after three breedings and those that were culled or died before they produced a litter were excluded from the experiment, and their data were eliminated from the analysis.

RESULTS AND DISCUSSION

During the growing period between 10 to 17 weeks of age, the **body weight** of 1D rabbits showed close similarity to that of the *ad libitum* group. Weights were significantly lower for 9H and particularly for 130R animals (Fig. 1), due to the differences in feed consumption (Table 1).

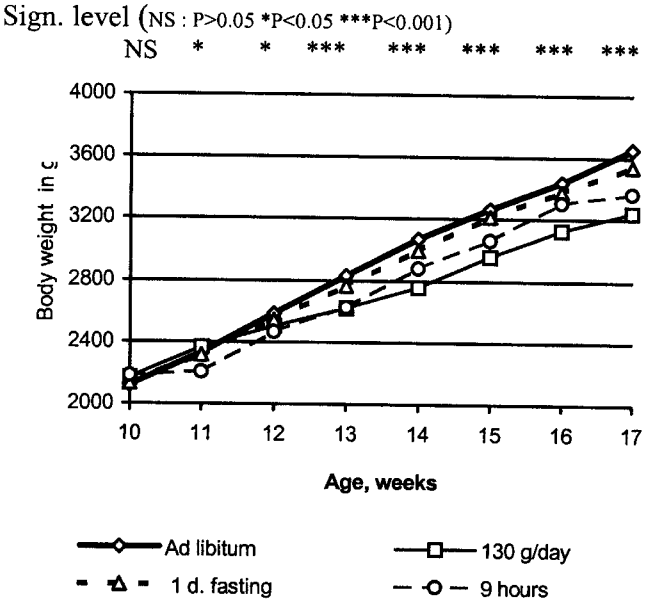

Figure 1 : Body weight of rabbits between 10 and 17 weeks of age

Table 1 : Effect of different feed restrictions on mortality, live weight, daily weight gain and feed intake in growing rabbits

	Groups							
	C		130R		1D		9H	
Initial number	50		49		48		48	
Final number	45		42		43		40	
Mortality rate, 10th to 17th week, %	10.0		14.3		10.4		16.7	
Live weight, g	LSM	se	LSM	se	LSM	se	LSM	se
10th week	2121	33	2170	33	2133	33	2180	33
17th week	3654[a]	45	3244[b]	46	3543[a]	46	3365[b]	47
First breeding	4031[a]	44	3924[ab]	43	3871[b]	48	3869[b]	46
Daily weight gain, g/day								
Weeks 10-11	31.8[a]	1.6	27.5[a]	1.6	28.5[a]	1.6	22.0[b]	2.2
Weeks 11-17	32.5[a]	0.8	20.2[c]	0.8	28.5[b]	0.8	28.2[b]	0.9
Weeks 17-22	23.8[a]	1.2	29.4[c]	1.2	23.0[a]	1.3	26.6[b]	1.3
Feed intake between g/day	174	-	133	-	165	-	142	-
10th and 17th week % of Control	100	-	76	-	95	-	82	-

Means within a row with different superscripts are significantly different (P<0.05)

In the first week of restriction, **feed intake** declined dramatically, by 41% in 9H, and by 11 to 12% in the other two groups as compared to C. The significantly lowest **daily weight gain** of 9H between 10 to 11 weeks indicates that in the first week the daily 9 hours' access to the feed was too short so they were unable to eat enough. Their lower weight and higher mortality at the beginning of restriction show that at this age a longer feeding time is necessary (SZENDRŐ *et al.*, 1988). Between 10 and 17 weeks of age, the **daily feed intake** was 5%, 18% and 24% lower in 1D, 9H and 130R than in the control, respectively. As a result, the weight of rabbits at 17 weeks of age in 130R and 9H was 11% and 8% lower (P<0.05) than that of the *ad libitum* group (Table 1). In agreement with other authors (MIRABITO *et al.*, 1994; BERSÉNYI *et al.*, 1999), feed restriction did not affect the **mortality rate** significantly.

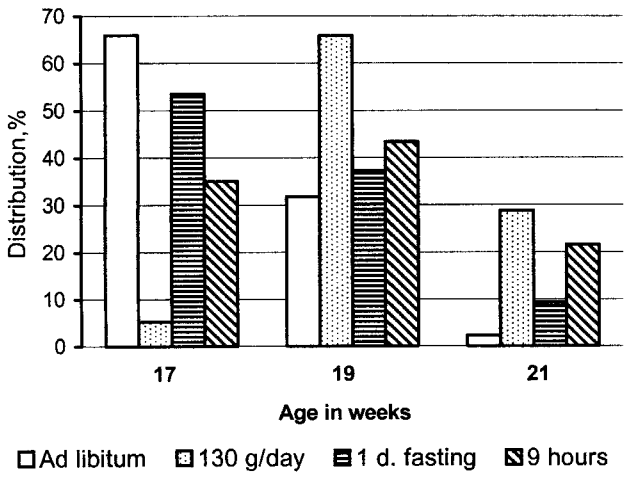

Figure 2 : Distribution of does according to their age at first breeding (when reaching 3.4 to 3.5 kg body weight)

By 17 weeks of age, 66% of C rabbits, 54% of 1D, 35% of 9H and 5% of 130R does reached the **breeding weight** of 3.4 to 3.5 kg (Fig. 2). The **average breeding age** in C, 130R, 1D and 9H groups was 17.7, 19.5, 18.1 and 18.7 weeks, respectively.

There were no significant differences in **average number of kindlings per doe** among groups. Compared to the control, however, the proportion of does with three deliveries was numerically higher in the 1D group, resulting in slightly more parities per doe (Table 2). Similar results were found by AUXILIA and MASOERO (1977).

The 130R does had the highest live weight at all times after first breeding. (Fig. 3).

Kindling rate of nulliparous restricted does was higher than that of the control (76 to 92% vs. 70%) but was significantly different only between the 1D and C groups (P<0.05). The better fertility rate generally observed in the three treated groups (P<0.10) can be explained by the older breeding age and by the favorable influence of flushing on ovulation (GOSALVEZ *et al.*, 1994; MAERTENS, 1995). Over the whole experimental period, kindling rate was the highest in 130R (71%) and 5 to 9% higher in the treated groups than in the control (Table 2). HARTMANN and PETERSEN (1995) observed improved fertility from the second parity onwards in the case of rabbits that were raised on 85% of the *ad libitum* feed level (72% vs. 65%).

Litter size, litter weight and **individual weight** of progeny at birth, at 21 and at 35 days of age in groups 130R and 9H were insignificantly higher than for the control. Birth litter size was the smallest in 1D does and their litters were significantly lower both in size

and in weight at 21 and 35 days of age than those of 130R and 9H females (Table 2). For the investigated traits the group x parity interaction was not significant.

Does secrete more milk if litter size at birth is larger (EL-MAGHAWRY *et al.*, 1993). The increase in milk production is, however, not entirely proportional to the needs of more sucklings. Therefore, one kit consumes less milk and so the individual weight will be lower (PETERSEN *et al.*, 1996). When both litter size and individual weight of suckling rabbits increase this could be only due to the higher milk production of the doe. In our experiment, in the larger litters of the 130R group, the 21-day individual weight of progeny exceeded that of the control (368 g *vs.* 343 g). This could be explained by the larger amount of milk per head in these litters, i.e. by the improved milk production of 130R does which had continuously higher body weight (good condition). HARTMANN and PETERSEN (1997) also noted better body condition and more milk secretion in does reared on 69% of *ad libitum* feed intake than in the control group.

In this trial **suckling mortality** showed close similarity among the four groups, although between 0 and 21 days of age it was higher in 1D than in C and 9H groups (Table 2).

Table 2 : Culling rate, body weight and reproduction traits of the rabbit does

	Groups								Effects	
	C		130R		1D		9H		group	parity
Initial number	42		38		42		36			
Final number	21		23		24		17			
Doe culling rate, %	50.0		39.5		42.8		52.8		NS	
Total no. kindled does	31		32		34		30			
Parity distribution, %										
one	41.9		40.6		38.2		46.7		NS	
two	38.7		37.5		29.4		43.3		NS	
three	19.4		21.9		32.4		10.0		NS	
Avg. deliveries per doe	1.77		1.81		1.94		1.63		NS	
Total no. of AI	84		79		92		73			
Total no. of kindling	52		56		62		49			
Kindling rate, %										
1st AI	70.0^{a}		75.6^{ab}		91.7^{b}		80.6^{ab}		*	-
2nd AI	56.3		64.3		50.0		54.5		NS	-
3rd AI	50.0		70.0		56.3		50.0		NS	-
1st to 3rd AI	61.9		70.9		67.4		67.1		NS	*
Total no. of litters	51		55		60		47			
Litter size	LSM	se	LSM	se	LSM	se	LSM	se		
Total	8.68	0.44	8.77	0.43	7.80	0.39	8.88	0.91	NS	***
Alive	7.99	0.46	8.30	0.44	7.59	0.40	8.77	0.94	NS	***
Nursed	7.92	0.33	8.22	0.32	7.41	0.19	8.68	0.68	-	-
21d of age	7.31^{b}	0.35	7.57^{b}	0.33	6.34^{a}	0.30	8.27^{b}	0.70	**	**
35d of age	6.95^{b}	0.35	7.30^{b}	0.33	6.01^{a}	0.30	8.15^{b}	0.70	**	***
Litter weight, g										
at birth	472	23.0	502	22.0	451	20.1	543	47.1	NS	***
21d of age	2451^{ab}	99.4	2760^{b}	95.2	2319^{a}	86.1	2848^{b}	200	**	***
35d of age	6032^{ab}	280	6295^{b}	269	5459^{a}	243	6761^{b}	564	*	***
Individual weight, g										
at birth	59.6^{a}	1.8	61.8	1.7	64.4^{b}	1.6	63.5	3.6	*	**
21d of age	343^{a}	12.2	368	11.7	389^{b}	10.5	345	24.5	*	***
35d of age	877	23.0	879	22.1	935^{a}	19.9	834^{b}	46.3	*	*
Suckling mortality, %										
Total litter loss	9.80	-	9.09	-	5.00	-	8.51	-	NS	NS
between 0 to 21d of age	7.65^{b}	-	10.1^{ab}	-	16.0^{a}	-	9.64^{b}	-	*	NS
between 21 to 35d of age	4.92^{ab}	-	5.18^{a}	-	4.41^{ab}	-	1.93^{b}	-	*	*

NS: P>0.05 *P<0.05 **P<0.01 ***P<0.001

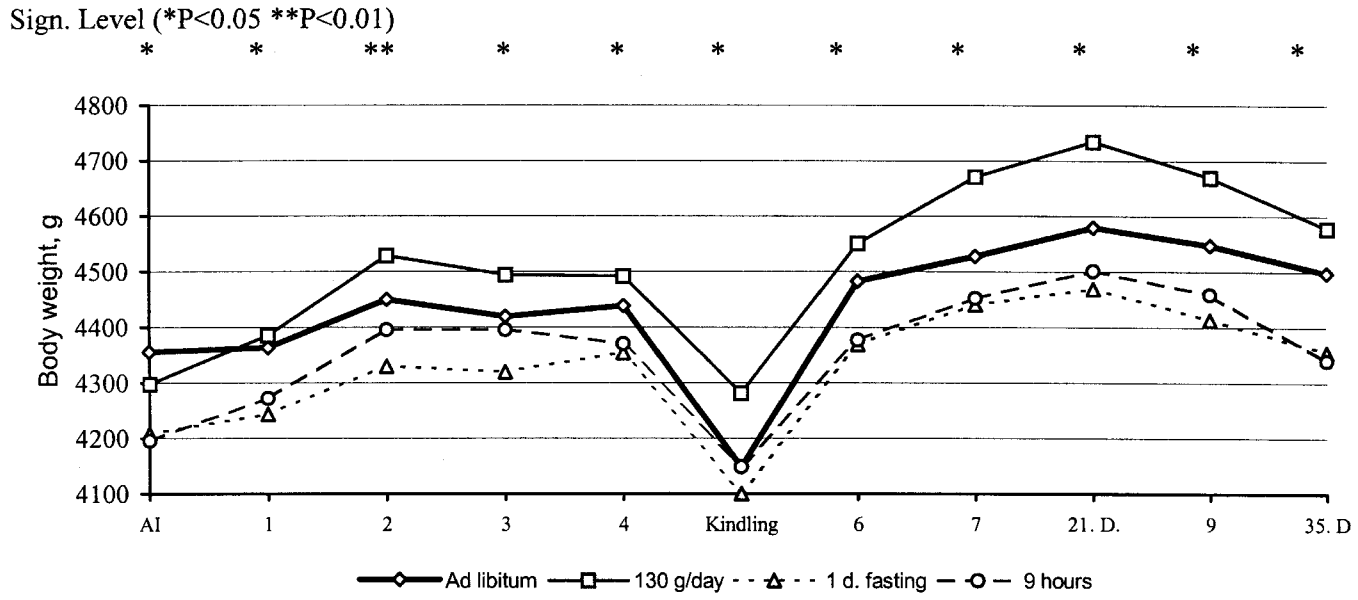

Figure 3 : Live weight of does between AI and weaning (1st, 2nd and 3rd littering)

CONCLUSIONS

According to our results due to the feed restriction the average breeding age (i.e. reaching 3.4 to 3.5 kg body weight) was postponed by 1 or 2 weeks, up to 19.5 weeks of age.

The one day fasting a week (1D) of growing replacement does did not improve their performance. Although these rabbits showed significantly better fertility at first breeding as compared to the control, they did not surpass the other groups in another traits during the whole experimental period, even here the suckling mortality was the highest. The poor reproductive performance of these does could be connected with their lowest body weight throughout the observations.

In comparison with the control, the groups reared by 9 hours daily access to the diet (9H) and 130 to 140 g/day feed portion (130R) showed better fecundity and prolificacy, these differences however, were not statistically verified. Nevertheless, these data indicate that examining the different methods of feed restriction of young female rabbits before breeding should be a promising way to increase their productivity and longevity.

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REFERENCES

AUXILIA M. T., MASOERO G., 1977. Studio sull' influenza dell livello alimentare sull' accrescimento e sulle attitudini riproduttive di giovani coniglie. *Ann. Ist. Sper. Zootec. Roma, 10, 2. 189-199.*

CIFRE J., VICENTE J. S., BASELGA M., GARCÍA F. X., 1994. Ovulation rate in lines of rabbits selected on different criteria. *Proc. 1st Intern. Conf. Rabbit Prod. Hot Climates, Cairo, 247-251.*

BERSÉNYI A., FEKETE S., ESZES F., HULLÁR I., SUKOLA S., 1999. Effect of feeding intensity on the development of growing rabbits. *Proc. 11th Hungarian Rabbit Day, Kaposvár, 71-75.*

EL-MAGHAWRY A., SOLIMAN A. M., KHALIL H. H., 1993. Doe milk production as affected by some genetic and environmental factors in New Zealand White and Californian rabbits under the Egyptian conditions. *Egypt. J. Rabbit Sci., 3(2), 141-150.*

FORTUN-LAMOTHE L., 1997. Effects of dietary fat on reproductive performance of rabbit does: A review. *World Rabbit Sci., 5(1), 33-38.*

GOSALVEZ L. F., ALVARIÑO J. M. R., DIAZ P., TOR M., 1994. Influence of age, stimulation by PMSG or flushing on the ovarian response to LH-RHa in young rabbit females. *World Rabbit Sci., 2 (2), 41-45.*

HARTMANN J., PETERSEN J., 1995. Vergleichende Untersuchungen zur Reproduktionsleistung von während der Aufzuchtphase restriktiv und ad libitum gefütterten Zuchthäsinnen. *Proc. 9th Symposium on Housing and Diseases of Rabbits, Furbearing Animals and Pet Animals, Celle, 97-105.*

HARTMANN J., PETERSEN J., 1997. Körper--gewichtsentwicklung und Milchleistung in den ersten drei Wochen der Lactation in Abhängigkeit von der Aufzuchtintensität von Hybridhäsinnen. *Proc. 10th Symposium on Housing and Diseases of Rabbits, Furbearing Animals and Pet Animals, Celle, 24-32.*

LE ROUX J. F., MÁTÉ CS., SZÓRÁD I., COLIN M., 1998. Replacement does: Growth and reproductive performances at the first kindling. *Proc. 10th Hungarian Rabbit Day*, Kaposvár, *57-62.*

MAERTENS L., 1992. Rabbit nutrition and feeding: A review of some recent developments. *J. Appl. Rabbit Res., 15, 889-913.*

MAERTENS L., 1995. Energy and nutrient requirements of does and their young. *Proc. 9th Symposium on Housing and Diseases of Rabbits, Furbearing Animals and Pet Animals, Celle, 76-91.*

MIRABITO L., GALLIOT P., SOUCHET C., BOLLENGIER J., 1994. Effect of a lighting program and of limited duration of access to the feed on the growth performance and feed conversion of fattening rabbits. *Proc. 6th French Rabbit Days, La Rochelle, 511-519.*

PETERSEN J., HARTMANN J., MENNICKEN L., 1996. Effects of prenatal on postnatal performance of does. *Proc. 6th World Rabbit Congress, Toulouse, Vol. 2, 103-106.*

STATGRAPHICS ® 1992. Reference Manual, Version 6.0, *Manugistics Inc., Rockville, MD, USA*

SZENDR ZS., SZABÓ S., HULLÁR I., 1988. Effects of reduction of eating time on production of growing rabbits. *Proc. 4th World Rabbit Congress, Budapest, Vol. 3, 104-114.*

TAG EL DEN T. H., MERVAT A. A., MOLNÁR J., 1988. Effects of restricting feeding periods on feed intake and digestibility of dry matter in rabbits. *Proc. 4th World Rabbit Congress, Budapest, Vol. 3, 213-222..*