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SECTION ON REPRODUCTION, GENETICS, SELECTION.

Effect of birth weight and litter size at suckling age on reproductive performance in does as adults.

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Pannon White rabbits born with light (39-43g) or heavy (63-70g) weights were raised in litters of 6 and 10 respectively, while those born with intermediate (53-56g) weight were raised in litters of 8 (n = 394). The does were of the same age and body weight at their first kindling. The does' birth weight had a significant effect on the number of inseminations necessary for the first kindling. Later on, however, birth weight no longer affected the conception rate. Heavier birth weights significantly improved doe performance. Litter size at birth was 12.4% (9.52 vs. 8.34 ; $P < 0.01$) higher , litter size at 21 days was 9.4% (7.64 vs. 6.92 ; $P < 0,01$) higher and litter weight at 21 days was 4.5% (2.70 vs. 2.58 ; $P < 0.05$) greater when the doe was born with greater weight. Total litter loss was 21.0% and 8.2% ($P < 0.01$) for the two groups respectively. The size of the litter in which the doe had been raised (6, 8 or 10) did not influence doe performance.

Effect of different feed restrictions during rearing on reproduction performance in rabbit does.

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Ad libitum fed ten-week-old NZW, Californian and German Large White littermate female rabbits were divided into four groups (n = 4x50) based on their body weight and genotype similarities, and were raised for another 7 weeks as follows : A- control group with *ad libitum* feeding ; B- access to a restricted 130g daily feed portion per head until 17 weeks of age and 140g/day until first breeding ; C- one day (24 hours) fasted every week ; D- 9 hours daily access to the diet (from 11 a.m. to 8 p.m.). When the young which were restricted in feeding reached 75 to 80% of their adult weight (3.4 to 3.5 kg) they were given an extra feed supply (flushing) for 4 days before first breeding. The does were reinseminated 9-11 days *post partum* and three consecutive deliveries were investigated. Between 10 to 17 weeks of age, the accumulated feed intake was 24%, 5% and 18% lower in groups B, C and D, respectively, compared to the control group (6482g = 100%). Thus, at 17 weeks of age the rabbits of group B and D weighed 11% and 8% less respectively than those fed *ad libitum* (3654g = 100%). Sixty-six percent of the control rabbits and 54% of group C had reached the breeding weight by 17 weeks of life, while 43% of group D and 66% of group B were placed on flushing with two weeks' delay; 30% of the latter were ready for breeding only after 21 weeks of age. The flushing effect could be detected in each treated group, but the greatest response was observed in the case of group B : due to their largest feed intake and the best conversion rate between 17 to 22 weeks of life. These rabbits showed the highest weight gain, compensation for their earlier weight lag. In group B and C, lower mortality loss occurred and more rabbits delivered three times, resulting in a higher number of kindlings per doe than in the *ad libitum* group : however, these findings were not significant. Conception rate in rabbits raised with different feed restriction levels improved insignificantly by 5 to 9% compared to the control animals. Litter size and litter weight at birth, at 21 days of age and at weaning were higher for groups B and D than for the control group, but these findings were not significant either. The females belonging to group B lost less weight at kindling and they showed the best body condition during the lactation period. Compared to the *ad libitum* group, in the more populous litters of group B, the individual birth and 21-day weight of sucklings did not decrease, which suggests that good body condition of does could result in improved intrauterine rearing ability and milk production.

In general, it was concluded that raising young rabbits with restricted 130g diet per day or with access of 9 hours' daily feeding time resulted in doe performances that neither decreased nor improved significantly.

Addresses are those of the only first authors

Effect of double suckling on the production of kits.

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In this experiment, the performance of two rabbit groups was compared as follows : one group suckled once a day as usual (S, n = 120) ; the other group had two nursing does and suckled twice a day [i.e., in the morning and in the evening (D, n = 128)].The individual daily milk intake of the S rabbits was 25.7g from birth to the 23rd day and 24.0g between days 24 and 35. The rabbits of group D suckled 22.7g and 21.1g milk in the morning and 24.3g and 20.6g milk in the evening in the respective periods. The rabbits consumed 83 and 74% more milk, respectively, than the S rabbits. The body weight of the S rabbits was remarkably lower at both 3 and 10 weeks of age : 0.32 vs. 0.55kg and 2.49 vs. 2.91kg. The S rabbits started eating a solid diet (feed mix) earlier ; they ate 14g and 55g in the 4th and 5th weeks, respectively The figures for group D were 5g and 37g/day in these two weeks. The D rabbits increased their feed consumption very rapidly after the weaning. The average daily feed consumption was 137g in group S and 158g in group D between weeks 6 and 10. As the D rabbits reached 2.5kg body weight 9 days earlier, their total feed consumption was lower between the 21st day and 2.5kg body weight (S : 5.3kg, D : 4.5kg). Mortality losses were small in both groups (i.e., 9.2% (S) and 4.4% (D) from birth to 70 days of age). The differences in dressing percentage (61.0% vs. 61.1%) and in the ratio of the fore, intermediate and hind parts in the carcass were non-significant. However, the amount of perirenal and scapular fat increased considerably with twice-a-day suckling/double suckling (S : 28.9g, D : 42.2g).

The effect of mother-litter separation on production performance in does and their kits.

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Pannon White does were subjected to artificial insemination 9-11 days subsequent to kindling (n = 931). Controlled suckling was systematically applied from 0 to 18 days post partum. Alongside the control group (C, n = 236) the does of the three experimental groups were prevented from suckling on the day prior to insemination (mother-litter separation, or MLS). The following day some of the does were inseminated two hours before suckling (B-2, n = 229), some immediately after suckling (B-0, n = 234), and some two hours after suckling (B+2, n =232). The effect of biostimulation led to only slight, non-significant improvement(s) in receptivity (0-7%) and fertility rate (1-5%). Litter sizes were 0.74 and 0.70 greater were recorded in groups B-2 and B-0, respectively, and no increase being observed in group B+2. The most considerable but non-significant effect of MLS was recorded after the first kindling subsequent to separation. On the day after the omission of suckling the quantity of milk produced by the does increased by 22% ; on the three subsequent days milk secretion in these does lagged behind that of the does of the control group by 33%, 15% and 6%, respectively. Consequently, two days after omission of suckling, as a symptom of the drying up of milk flow, the milk secreted was found to contain higher levels than previously of dry matter (by 4.2%), fat (by 1.7%), protein (by 2.6%) and ash (by 0.53%) ; however, these values later returned to levels approaching the original values. Due to the omission of one suckling the weight of suckling and growing rabbits declined by 20-34g, no compensatory growth being observed either before or after weaning.

In vivo estimation of changes in body fat content of lactating rabbit does using X-ray computer tomography.

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X-ray computer tomography (CT) and chemical analysis were used to determine the changes in body fat content of 28 Pannon White rabbit does during their first lactation. The animals were scanned by CT immediately after kindling and on the 14th and 28th day of lactation. After each CT procedure a group of the rabbits was slaughtered and the fat content of their empty body was chemically analysed. During CT procedures, twenty-seven scans per doe were taken within the body interval between the scapular arch and the end of the femur. The CT images were processed by a computerised imaging technique, producing three-dimensional (3D) histograms. The 3D histograms gave a clear representation of the fat deposits, with different peaks in the scapular, abdominal and pelvic region.

For the estimation of the total body fat content in *vivo*, index numbers were created from the X-ray density values of the pixels. These indices showed a substantial decrease (45%) in total fat content throughout the lactating period. To check the accuracy of prediction regression analysis was applied between the index numbers and the chemically analysed fat content, whereupon high correlations (r = 0.90-0.92) were found.

Factors influencing the effectiveness of *post partum* artificial insemination.

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Production of Pannon White does inseminated *post partum* (PP) was evaluated in a one-year experiment. Besides insemination, does were treated with a single 1.5 μg GnRH analogue injection but PMSG was not supplied and no biostimulation was performed. From the 1305 AI, 663 PPs were carried out where the average conception rate (CR) was 46.8% and the total litter size (LS total) was 7.7 kits. The CR of does not conceiving the first time was 71.8% and was 8.85 kits for LS total. The performance of the PP group was influenced by several factors. Young does inseminated after the first and second parturition conceived significantly less (with CR of 36.1 and 30.8%, respectively) compared with older does having CR values of 47.9 to 52.4%. The LS total of the first litter was the smallest (6.73), the fourth proved to be the greatest (8.26), and no significant difference was revealed for the rest of this trial (7.64 to 7.76 kits). The best conception rate of 50.0 to 56.8% was achieved during the period from February to July whereas the weakest was recorded in October and November (with CR of 24.7% at $P < 0.05$). The litter size was the greatest when the does were inseminated between February and May, and it was the smallest when they were inseminated between October and January (with LS total of 8.46 to 8.66 kits and 6.19 to 6.21 kits, respectively, at $P < 0.05$). The rate of conception was influenced significantly by the size of the previous litter determined on the 21st day. Does losing the total litter (with CR of 33.3%) and those of having litter size of 10 or more (CR being 29.3%) conceived successfully, whereas CR values were 48.1 to 53.3% when litter sizes were between 1 and 9. The LS total was not dependent on the size of the previous litter. In the PP group the differences between parturition and the next insemination were 0 to 3 day(s). The best results were achieved from AI on day 0 with CR of 58.8% and LS total of 7.06 kits ($P < 0.05$).

Effect of genotype on some meat quality traits in rabbits.

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For this study, 344 rabbits were used. The animals originated from matings of pure breeds : New Zealand White and Tan, and their reciprocal crosses (F_1) and back-crosses (R_1). Two carcass quality traits (weight of warm carcass and cooled carcass), and 9 meat quality traits were examined : pH at 45 min and at 24h after slaughter, absolute and relative drop in pH, water and protein content (%), water holding capacity (%), thermal leakage (%) and lightness (%). The data were evaluated by analysis of variance. The linear model contained the fixed effects of genetic group, sex, and interaction. Additionally, the phenotypic correlation coefficients among the traits were estimated. Genetic group had a significant influence for all traits. Sex significantly influenced the following traits : water and protein content, water holding capacity, thermal leakage, and lightness. For the traits which were affected significantly by sex, the interactions of the two effects were also significant. Some of correlation coefficients differed significantly from zero, but most correlations had small or moderate values.

Results of crossing two rabbit breeds concerning body weight and daily gain.

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The experiment was conducted under traditional feeding conditions. A total of 1420 rabbits were used which originated from purebred matings of the New Zealand White and Tan breeds and from reciprocal and back-crosses of these two breeds. During the rearing period at the ages between 14 and 42 days, at 7-day intervals, body weights and daily gains were measured. The traits involving body weight and daily gain were subjected to analysis variance. The linear model consisted of fixed effects of genetic group, sex, and interaction, and the linear regression of the size of the litter in which the rabbit was born. An influence of genetic group and sex on body weight and daily gain in rabbits at different time intervals during the rearing period was detected. In some cases, the interaction between genetic group and sex was also significant. Some genetic groups showed a heterosis effect for certain traits.

The results of rearing female rabbits of different genotypes.

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Rabbits used in this study consisted of 228 litters of different crossbred groups of New Zealand White (NZW) and Tan breeds. The experimental data were divided into three series according to the following scheme :

Series I

♀♀ NZW X ♂♂ NZW
♀♀ Tan X ♂♂ Tan
♀♀ NZW X ♂♂ Tan
♀♀ Tan X ♂♂ NZW

Series II

♀♀ NZW X ♂♂ NZW
♀♀ Tan X ♂♂ Tan
♀(♀ NZW x ♂ Tan) X ♂ NZW
♀(♀ NZW x ♂ Tan) X ♂ Tan
♀(♀ Tan x ♂ NZW) X ♂ NZW
♀(♀ Tan x ♂ NZW) X ♂ Tan

Series III

♀♀ NZW X ♂♂ NZW
♀♀ Tan X ♂♂ Tan
♀ NZW X ♂(♀NZW x ♂ Tan)
♀ NZW X ♂(♀Tan x ♂ NZW)
♀ Tan X ♂(♀NZW x ♂ Tan)
♀ Tan X ♂(♀Tan x ♂ NZW)

The animals from a purebred mating in every series were treated as the control group. The observations from birth to weaning (42 days) consisted of the following data : litter size at birth, 7, 14, 21, 28, 35 and 42 days. For every rearing period, the loss rate and the rearing effectiveness was calculated. The data were evaluated using one-way analysis of variance. Basing on these evaluations, it was concluded that in the series I there were significant differences among some genotypes in litter size at every age interval examined. The contrast analysis carried out on the series showed the presence of heterosis effect in the progeny from the reciprocal crossbreeds. In the series II, in which the females originated from NZW x Tan, and the progeny had ¾ contribution of one of the two initial breeds, only differences between the examined genotypes were noticed. The contrast analysis revealed only the heterosis effect in litter size at 7th and 14th day of the rearing period. The effectiveness of rearing in the series I ranged from 72.8 to 86.65%, and significant differences among different genotypes were detected. Both reciprocal crossbreed F_1 groups showed their superiority to contemporaneous purebred animals. In the series III (purebred females) no significant differences among the results of rearing were detected.

Estimation of crossing effects on fattening and slaughter performance of rabbits.

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In this crossbreeding experiment, estimates of genetic parameters for fattening and slaughter performance of four breeds of rabbits were involved. Breeds were Flemish Giant, Champagne d'Argent, Giant Chinchilla and Dutch. Initially, a test was made to determine the breed performance in weaning weight, fattening weight, daily weight gain, slaughter yield, weight of back and thighs, weight of usable pieces of meat, and skin weight. The F_1, F_2, and the reciprocal crosses were also evaluated. The genetic parameters were estimated by the model of DICKERSON (1973). Significant additive genetic effects was noted for all breeds in fattening weight, daily weight gain, skin weight and percentage of skin. Maternal genetic effects were obtained for fattening weight, daily weight gain, weight of back and thighs, weight of usable pieces of meat and skin weight. Seldom were significant estimates found for maternal heterosis and recombination effects.

The effect of rabbit genotype on meat quality.

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The aim of the study was to compare selected quality parameters of meat in different breeds of rabbits (Termond White, Alaskan, Grand Chinchilla, Californian, New Zealand White, hybrid line Genia and a meat line). The animals were kept from weaning at 35 days of age to reaching a body weight of 2500 ± 100g either under confined conditions in multi-storey cages made from galvanized wire-mesh or on litter in wooden cages situated in the open air. The rabbits were fed a complete pelleted feed containing 16.5% crude protein, 13.3% crude fibre, 2.9% crude fat, and 2450 kcal metabolizable energy. The feed was made from clover meal, ground barley, ground maize, wheat bran, powered milk replacer, meat-and-bone meal, fodder yeast, dicalcium phosphate, NaCl and polfamix FK supplement. Chemical analyses were performed to determine dry matter, crude protein, crude fat and the content of fatty acids in samples of meat taken from the *longissimus dorsi* muscle (saddle). Analysis of variance showed significant differences in some parameters. Meat quality was influenced by both factors, the genotype of the animal and the management system. In summing up the results, Californian rabbits were characterized by higher indicators of meat quality and the best percentage of fatty acids in the *longissimus dorsi* muscle.

Phenotypic correlations among some parameters of the digestive tract of rabbits from two age groups.

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The experiment was carried out on 206 rabbits of two breeds : New Zealand White and Tan, as well as on reciprocal crossbreeds of these two breeds. The animals were slaughtered at the age of 70 or 140 days and, after removing the digestive tract, the following segments were examined : **stomach** (height, diameter at the cardia, the greatest diameter of stomach body and pyloric part) ; **duodenum** (length, diameter of the beginning part and the end) ; **jejunum** (length); **ileum** (length, diameter of the ampule) ; **cecum** (length, diameter of the beginning part right above the exit to the ileum, diameter of the end part on the border of the vermiform appendix) ; **vermiform**

appendix (length, diameter) ; length of the **cecum** and the **colon** ; diameter of the **colic ampule** ; diameter of the **end part of the sigmoid colon** ; length of the **sternum**, length of the **abdomen**. Every part of the digestive tract was measured and, based on these data, phenotypic correlations were estimated among the measured traits of the corresponding parts, as well as among different traits of individual parts of the digestive tract. Most of the correlation coefficients ranged between approximately 0.2 and 0.5. Corresponding correlation coefficients in different age groups were in some cases different, which can be attributed to the allometric development of the organ.

SECTION ON NUTRITION

The effect of increased zinc (Zn) supply on weights of certain organs and on growth of rabbits.

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Sixty rabbit does with their litters were fed from the 10th day of lactation with the mixture (1:1) of "standard feed" (Kun/stand) and enriched "lactation feed" (Kun/lact). Lactation feed for experimental animals (n = 34) was supplemented with 500mg of Zn (from Zn-methionine). Combining these two feeds (standard and lactation 1:1) the Zn supply in control group (C) was 257.1 and in Zn group (Zn) was 552.9mg of Zn per kg of feed dry matter (DM). Young were fed from weaning to the 71st day of age with Kun/stand : in control group the Zn supply was 292.2 and in Zn group 938.8mg of Zn/kg of feed DM. The growth of young (n = 420) were measured from 10th day to 66th day of life, while feed intake and feed conversion efficiency were monitored from 38th to 66thday. 116 rabbits were slaughtered on the 71st day : the slaughter weight, carcass, skin, liver and kidney weights and dressing percentage were measured. The data were subjected to the SAS GLM procedure. Increased Zn supply during lactation (about 250mg) and during growth (about 650mg) significantly ($P \leq 0.05$) increased live weight of rabbits after 38th day (live weight on 66th d : C 1931.1, Zn 2064.6g), daily weight gain (from 10th to 66th d. : C 34.13, Zn 37.56g/day), daily feed intake (from 38th to 66th. : C 99.84, Zn 124.14g/day), slaughter weight (C 2167.8, Zn 2288.8g), carcass weight (C 1166.3, Zn 1226.2g), and dressing percentage (C 51.49, Zn 54.16%), but decreased liver weight (C 89.9, Zn 75.4g). However, addition of Zn did not affect feed conversion efficiency or skin and kidney weights.

Use of a multiple phase feeding programme during the rearing of fattening rabbits.

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At present, intensive rabbit meat production relies on a commercial feed mixture used in the production and also in the fattening phase. Considering the nutritional needs, it is recommended however, to feed separate feed mixtures to the does in the suckling period and the kits after weaning. In the trial presented the effects of phase feeding programmes with 3 different feed mixtures on the performance of the does and the kits were tested. A total of 28 ZIKA and ZIKA-terminal cross does were used in the experiment, which produced a total of 41 litters in two consecutive trials. The kits remained with the does for 4 weeks and were fattened in groups after weaning until the 8th week of life. The does were mated with bucks from a cross between Deutsche Riesen, grau and ZIKA does. The mating of the does was done post partum in trial one and 10 days post partum in trial two. The does were assigned to three groups with different phase feeding programmes. In group I the does were fed a special diet for does permanently. In group II the does diet was replaced by a special diet for kits after two weeks of suckling. In both programmes the kits were fed this diet from weaning to the end of the 6th week. Group III does s well as all fattening rabbits in the 7th and 8th week received the conventional commercial diet. Results showed a positive effect of the doe diet on milk performance and thus on the growth of the kits during the suckling period. The lowest rate was achieved with the conventional commercial diet due to lower milk performance of the doe. Does fed on the kit diet after two weeks of lactation produced less milk in the 3rd week of lactation and thus growth rate of the kits was initially reduced compared to does fed the doe diet for a longer period. No significant differences were found in the mortality rate, since the overall level of mortality was very low. The scoring of the area around the anus of the kids at the age of 6 weeks in view of the presence of diarrhoea showed no significant differences. Only in group II, where kits were fed a diet for kits during the suckling period, all kits demonstrated a cleaner anus area.

Effect of weaning age and solid feed distribution before weaning on the caecal fermentation pattern of young rabbits.

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The effect of early weaning and dietary shift from milk to milk and pellets on the caecal composition and fermentation pattern of young rabbits were studied. A total of 15 conventional litters, of 8 young each, were allotted to 5 experimental groups (A-E).

Weaning was performed at 18 days of age for treatment A or at 32 days for the others, which were fed pellets at the age of 18 (B), 22 (C), 25 (D) and 28 (E) days of age. Milk intake and pellet intake, fed separately from their mother, were measured daily. Out of each litter, 1 young rabbit was sacrificed at 22, 25, 28, 31, 35, 42, and 56 days of age to collect caecal contents and record the pH. Part of the caecal contents was immediately diluted with a buffer solution to analyse total volatile fatty acids (VFA), lactate (L) and ammonia nitrogen ($N\text{-}NH_3$) concentration. The remaining part was lyophilised to determine crude protein (CP), neutral detergent fibre (NDF), and acid detergent fibre (ADF) content.

Age of solid feed distribution significantly affected caecum biochemical parameters whereas weaning age did to a lesser extent. Early feeding (group A, B) led, already from day 22, to a high caecal VFA concentration ($P<0,05$), to a stabilisation of the ratio propionate:butyrate and to a lower pH ($P<0,01$). On the contrary, a delayed pellet distribution (group C, D, E) led to lower final VFA concentration ($P<0,05$) and to a higher pH ($P<0,01$). Hence, on day 56, caecal total VFA concentration from treatment A to E was : 92, 79, 55, 49 and 51mmol/kg^{-1}, respectively, and the corresponding pH was 5.8, 6.1, 6.3, 6.6 and 6.5. The C_4 was completely absent from the fermentation pattern of the exclusively milk fed kits. When these kits started to consume solid feed, butyrate appeared and the ratio propionate:butyrate reversed with increasing pellet intake. On average, $N\text{-}NH_3$ concentration was not affected by age of solid feed distribution, although this tended to be higher in exclusively milk fed rabbits whereas L was higher in early fed ones (groups A, B). Caecal contents chemical composition (CP, ADF and NDF %) was not affected by weaning age.

Effect of feeding on the milk production of female rabbits.

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The growth of rabbits from birth to 20-21 days of age depends on the milking ability of the doe. The composition and amount of milk depends on many factors, the most important being adequate feeding of lactating females. New Zealand White rabbits were kept on deep litter in boxes, under confined conditions of an unheated house. Three experimental groups consisted of 20 female rabbits each : group I was given pelleted feed made according to the authors' own formula which contained 18.43% crude protein, 3.24% crude fat and 14.12% crude fibre ; group II was offered pelleted feed supplemented with 3% milk replacer "Ascolak" ; group III was given pelleted feed enriched with a vitamin-mineral supplement, commercially known as "Vitaperes". The females were serviced semi-intensively (i.e., within 10-20 days of kindling), and the course of the lactation was observed from litters 1 to 15. The following characteristics were observed : litter size and neonatal growth, litter weight (the animals were weighed daily at the same time from 1 to 21 days of age), mortality and causes of mortality and organoleptic evaluation of milk samples. The results were used to calculate the mean amount of milk secreted during 21 days of the lactation in each group and parity. The milk yield of the primiparous females was found to be relatively low in all the groups. It increased considerably during the 2nd parity and persisted until the 11th parity. It was observed to decrease gradually with the subsequent kindling. The best performance was found in group III, where vitamin and mineral supplements had a beneficial influence on the amount and composition of secreted milk. This observation was made when analysing the mean weight of 1 rabbit at 6 and 21 days of age.

SECTION ON ETHOLOGY, HOUSING AND WELFARE.

Investigations on influence of different artificial light regimes in comparison to natural daylight on reproductive parameters in female rabbits.

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The aim of the experiments was to investigate the influence of two artificial photoperiod regimes (16L:8D and 8L:16D) in comparison to natural daylight on fertility of rabbit does (rate of fertility, litter size and litter weight at birth and at weaning, young rabbit index = number of alive born kits per 100 artificially inseminated does.) Artificial insemination (AI) took place in 33 day rhythm, with injection of 1,2µg Buserelin (Receptal®) i.m. briefly before AI. Fresh collected, diluted mixed semen was applied. A total number of 62 does (21 x natural daylight, 21 x 16L:8D, 20 x 8L:16D) were considered from December 1997 to January 1999. Data from 508 AI were analysed. Does were kept in single cages (flat decks) with nest boxes. The nutrition was realized with special pelleted feed for breeding rabbits fed *ad libitum*. Some important results considering fertility performance of does kept under different light regimes are summarised in the table.

	Natural light	16h L: 8h D	8h L: 16h D	Sign.
n	113	114	113	
Rate of fertility (%)	65.7	65.9	69.3	
Litter size at birth	8.7	9.5	9.0	P<0.05
Litter weight at birth (g)	568	614	557	P<0.05
Young rabbit index	522	577	505	
Litter size at weaning	7.7	8.2	7.9	P<0.05
Litter weight at weaning (kg)	4.77	5.07	4.78	P<0.05

Does kept under artificial photoperiods (16L:8D, 8L:16D) tended to reach a higher rate of fertility and a significant higher litter size at birth and at weaning compared with rabbits does kept under natural light conditions. Under the influence of 8L:16D does regime reached by far the highest number of kits based on 100 inseminated does (AI). Does housed under artificial light with short day length achieved a higher number of alive born kits per 100 inseminated does by 84 compared with females kept under natural light during whole year. Within the investigated conditions, artificial photoperiod was revealed to be the most effective in terms of fertility and reproduction.

Investigation on influence of size and structure of get-away cages on suckling behaviour and doe-litter relationship of rabbits.

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Up to now the question is not answered clearly if occurrence of several suckling events per day has to assess a species-specific behaviour or a behavioural abnormality caused by cage confinement conditions. Investigations should show if allowance of more space in get-away-cages (1.5x, 2x and 3x size of 50 x 70 x 70cm cage with laying place in 25cm height - unstructured cages) or presentation of a tunnel as an entrance to litter box (structured cages) can influence frequency of suckling in predominately New Zealand White rabbits. Due to lack of space in cages with 1x and 1.5x size, no tunnel nor curtain was installed to prevent direct contact of vision between doe and kits. But, curtain was destroyed soon after start of use. Infrared video recordings were made in 329 x 24 hr periods in unstructured cages of different sizes and 328 x 24 hr periods in structured cages with tunnel or curtain. No distinct differences between structured and unstructured cages in number of suckling events per day (1.24 and 1.33 sucklings/24 hr, respectively) and duration of suckling act (205, 200 sec. per suckling, respectively. Frequency of sucklings per 24 hr tended to decrease with increasing size of get-away-cage both in unstructured cages and in two cage sizes (2x and 3x size) with tunnel to nestbox.

	Number of sucklings / 24h	Duration of suckling event (sec.)
Cage *with* structure		
1 x size	1.33	214
1.5 x size	1.33	192
2 x size	1.25	216
3 x size	1.11	198
Cage *without* structure		
1 x size	1.37	202
1.5 x size	1.44	205
2 x size	1.26	203
3 x size	1.26	188

*including the results of *Seitz* (1997)

The mean duration of the suckling event involving the average of 427 sucklings in structured and 408 sucklings in unstructured cages were significant but no systematic trends occurred. Differences showed no distinct influence of cage size or cage structure on suckling behaviour.

Experiments on the temperature preference of rabbits.

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The spreading of the domestic rabbits throughout different climatic zones, from extreme cold to tropical conditions, shows that rabbits have a wide spectrum of tolerance to ambient temperatures. There are various studies on the adaptation to high temperatures. There is, in contrast, little information on the reaction of rabbits to low temperatures. The recommendations for ambient temperatures are 20°C for weaned rabbits and 10 to 15°C for breeding rabbits. These recommendations are made for rabbits in cage systems. Lower temperatures are generally considered acceptable under deep litter conditions. Experience from practical rabbit production have shown that the animals are relatively resistant to cold conditions. In order to test the preference of fattening rabbits to low temperatures, a series of experiments have been carried out. In the first experiment, the animals had free choice of compartments to 15, 20 and 25°C, respectively. Feed and water were offered in all compartments and the illumination and ventilation were kept constant under all conditions. The rabbits were tested from weaning (28 days) up to slaughter age, and feeding and resting activity behaviours were recorded continuously by passive infrared sensors. There was a clear preference for the lowest temperature in both, the activity and resting phases of the animals. This tendency was observed from the beginning of the experiment, and the preference for the cold environment increased with age. Feeding activities were found to be similar in all temperatures and resting was preferably carried out in the coldest environment. In further experiments, the preference for 10 and 15°C was tested. There was a general preference for the lower temperature in the active phases while resting was observed preferably at the higher temperature. The reported choice tests have been carried out on solid floor with a thin layer of wood shavings. Since the temperature preference is known to depend on the conductivity of the floor, the preference for different floor types, solid litter floor and plastic slats was tested. While the animals had free access to both floor types, the ambient temperature was continuously raised from 10 to 30°C and subsequently lowered again to 10°C. Independent of temperature, the activity of the rabbits was higher on the litter floor than on the plastic slats.

Influence of artificial and natural light on spermatological parameters of rabbits.

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The aim of the investigations was to analyse the influence of two different photoperiods (16hr L:8hr D, 8hr D:16hr L) in comparison to natural daylight during one year on sexual activity and on parameters of semen quality (at least 12 bucks per group). Semen of rabbit bucks was periodically collected once a fortnight. Rabbit skin, a teaser doe and an artificial vagina were used for collecting semen. Behaviour of bucks during semen collection was assessed during 827 collections (282 x natural light, 285 x 16L:8D, 260 x 8L:16D). Variability in sexual activity between bucks housed in different photoperiods were observed. Bucks under natural light condition had the highest sexual activity. Spontaneous copulation without presence of a teaser doe was found at 20% under natural light conditions, at 15% under 8L:16D and at 8% under 16L:8D. No ejaculation appeared at 2% of all cases under natural light, at 3% under day length and at 5% under shorter day length. Results of spermatological investigations are summarised in the table. It was shown that 8L:16D led to significantly better values in nearly all parameters of semen quality.

	Natural light	16 L:8D	8D:16L
Ejaculate volume	0.75	0.74	**0.93**
Colour [1]	2.01	2.01	**1.65**
Consistency [2]	2.10	2.05	**1.62**
Motility [3]	3.16	3.26	**3.43**
Actively swimming sperm (%)	63	63	66
Spermatozoa (x 10^6)			
- Per ml	535	605	**651**
- Per ejaculate	405	473	600
Morphologically abnormal sperm (%)	11.2	**10.6**	11.5

[1] = 1 ivory coloured, 2 opaque, 3 transparent, 4 yellowy
[2] = 1 creamy, 2 milky, 3 whey-like, 4 watery
[3] = 0 no motility (m), 1 hardly m, 2 few m, 3 average m, 4 above average m, 5 high m.

Suckling behaviour and doe-litter relationship of different rabbit breeds in traditional housing.

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Previous investigations with rabbit breeds under intensive keeping conditions have shown that rabbit does nurse their kits more often than once a day. The aim of this analysis was to answer the question whether several suckling events per day also occur in different rabbit breeds kept under traditional conditions. In 268 x 24 hour-infrared video recordings, rabbit does of two large, two medium, two small and one dwarf breed kept in traditional concrete pens (80x60x60 cm) with straw as litter material were investigated under the aspects of frequency and duration of suckling events in 24 hours. Averaged over of all groups, the following suckling frequencies were observed : once a day on 45.5% of all 24 hr-cycles, twice a day on 45.9%, three times on 7.1% and four and five times on 1.5% of all days (mean : 1.64 suckling events per day with an average duration of 441 sucklings with 210 sec). Distinct differences between breeds were found in frequencies of days with two or more suckling periods, in mean number of suckling per 24 hr and in mean duration of suckling event :

	Breed			
	Large	Medium	Small	Dwarf
Frequency of day with ≥2 suckling events (%)	66.0/66.7	30.4/35.7	78/0	58.5
Number of sucklings/24h	1.77/1.85	1.30/1.36	2.10/1.00	1.61
Duration of suckling events (sec.)	230/233	211/205	192/197	192

With decreasing body size, frequency and duration of suckling tended to decrease (except one small breed doe with two litters and only one kit/litter of one dwarf breed doe). The highest frequency of suckling was found in 2nd week of lactation (1.89 suckling events/24 hr). Does have initiated suckling activity because siblings have not left the nest during 2nd week of age. After a decrease in suckling activity in 3rd week of age (1.53 suckling events/ 24 hr) and in the 4th week, an increase in frequency of suckling was seen (1.60 x in 24 hr) caused by rising activity of siblings. It was shown that a distinct influence of day-night-rhythm on suckling behaviour (42.6% of all suckling events) took place in evening hours between 6 and 11 p.m.

Reproductive performance of female rabbits housed on straw litter.

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A total of 150 New Zealand White female rabbits were kept in boxes (90x70x90 cm) on litter made from cut wheat straw. Pelleted feed was given throughout while providing rabbits with constant access to drinking water (nipple drinkers). Foundation stock females were serviced semi-intensively (i.e., within 10-20 days of kindling). The young rabbits were weaned at 35 days of age, after which time the litter was removed and the boxes were

disinfected. The results showed that deep-litter system is recommended for the following reasons : it enables rabbits to be produced throughout the year, making the use of heaters unnecessary ; the mean number of litters per annum was 7.1 per doe ; the mean number of reared rabbits was 7.9 per litter ; the mean weaning weight of rabbits (35 days of age) was 880 g. The only disadvantage of this system was the relatively low utilization of cages and the need to perform many tasks manually.

Economics of rabbit production in Slovenia.

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Gross margin calculations have been applied to study current profitability of rabbit production in Slovenia. Intensive production has been assumed and data from some larger commercial farms were collected to simulate technology and economics achievable by market oriented rabbit farmers. Crude fixed cost estimation has been made to assess income, achievable by fully employed rabbit breeders. Professional breeders with 250 doe cages can achieve income of approximately 2,600.00 SIT if they manage successful marketing. Actual results depend highly on rearing performance (mortality, litter size and litter interval), feed conversion and product prices. With all these parameters taken into account, average income could be very promising. Only the most successful breeders have the opportunity to achieve attractive financial results in marketing of rabbit weaners. Possibility of low or even negative income is not to be ignored. Opposite to this specialisation, fattening units could achieve much better results if they manage to be part of a well organised production chain.

SECTION ON DISEASES, DISEASE PROPHYLAXIS.

Investigations on the effect of feed additives on the gut microflora of meat rabbits.

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The gut microflora of healthy rabbits consists mainly of gram-positive bacteria (i.e., *bacilli, lactobacilli*). Disturbance of the ecological balance can cause severe damage in the gut. The establishment of *E.coli* or *Cl perfringens* is considered to play an important role in the development of intestinal diseases ("katarrhalic enteritis", "hemorrhagic typhlo-colitis") which often occur in young rabbits. The effect of feed additives on the gut flora of growing meat rabbits was investigated, particularly concerning the colonisation of enteropathic bacteria. *Flavophospholipol, Polymycin B, Robenedin, Lerbek®, Olaquindox, Enrofloxacine, Chlor-tetracycline* and *Aureo-S-700®* (Chlortetracycline/Sulfadimidine) showed no effect. Antibiotics react in a different manner when given orally. *Penicillin V, Ampicillin, Cephalexin, Lincomycine* and *Spiramycine* induced disorder of intestinal flora balance, followed by diarrhoea. *Tetracycline, Doxacycline, Chloramphenicole, Erythromycine, Spectinomycine, Oleandomycine* and *Tylosine* did not change the composition of the gut microflora.

The appearance of enterocolitis with high mortality in middle Germany.

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Rabbit enterocolitis which in recent years diffused into western European countries, has appeared in middle Germany since only 1997. Weaned rabbits first present diarrhoea which turns to mucoid enteritis and finally constipation. Older rabbits present peritonitis, peracute lung inflammation or haemorrhagic diathesis. Bacteriological studies reveal a variety of pathogens, up to five in one animal. The presence of enteropathic *E.coli* serotypes correlates with particularly dramatic situations. Most frequently O109, O128 and O132 are identified, sometimes O15, rarely O103. Bacterioscopic examination of gram stained caecum smears indicates infection with *Clostridium sporoforme* in about 70% of the cases. After isolation its toxicity is studied by the biochemical method. *C. spiroforme* liberates a Jota-like toxin which inhibits the polymerization of actin. It causes paralysis of intestinal smooth muscles and inhibits the formation of stress fibres in white blood cells, affecting migration and phagocytosis. One further effect is permeabilisation of blood vessels. The treatment of rabbits with zinc-bacitracin is successful only before the onset of toxic alterations and after the suppression of *E.coli* infections. Permanent treatment selects resistant strains.

Differentiation of *Pasteurella multocida* isolates from rabbits by macro-restriction analysis.

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Bacteria of the species *Pasteurella multocida* play an important role as causative agents of pulmonary diseases in rabbits. A detailed characterisation of the isolates is required to identify pathogenic strains and to monitor their spread within and

considered the method of choice in epidemiological studies. Macrorestriction analysis represents a molecular typing method which is based on restriction analysis of the whole cell DNA with a rare-cutting endonuclease and subsequent separation of the resulting fragments in pulsed-field gel electrophoresis. As a result of this procedure, a characteristic fragment pattern is obtained from each bacterial isolate. A total of 28 *Pasteurella multocida* isolates from rabbits, pre-investigated for morphological characteristics, serotype, biochemical capacities, whole cell protein patterns, toxin production and ribotyping patterns, were subjected to macrorestriction analysis. The data obtained showed that macrorestriction analysis is generally applicable to *Pasteurella multocida* isolates and mainly confirmed the results obtained with classical typing methods as well as ribotyping. Pasteurella infections within one closed production line (breeding to fattening units) were referred to the spread of a single *P. multocida* strain even among geographically distant production units.

The value of immunoprophylactic measures in combating infectious diseases of rabbits.

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Commercial preparations are available in Germany against Myxomatosis, RHD and Rhinitis. The purchase of these rabbit vaccines by veterinary practices in all 16 German states was evaluated using continuously derived data by an independent market research institute. Homologous live vaccines based on attenuated strains and heterologous live vaccines using the rabbit fibroma virus (Shope virus) are used against Myxomatosis. Analysis of a 5-year period (1994 to 1998) showed that on average 91% of the vaccines used were homologous ones. Inactivated vaccines based on hepatic tissue from rabbits infected experimentally are used for vaccination against RHD. In the period 1994 to 1998, 47% of vaccinations against RHD were carried out in western German states and 53% in the eastern German states. Vaccination is not carried out uniformly in all German states. An inactivated vaccine containing *Pasteurella multocida A*, *Bordetella bronchiseptica* and *Pasteurella toxoid* has been licensed in Germany since 1997. Vaccinations against Rhinitis were carried out more often in western than in eastern German states. The value of prophylactic vaccinations varies geographically depending on the incidence of individual diseases.