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SECTION ON REPRODUCTION AND GENETICS

Effect of male presence before artificial insemination on receptivity and prolificacy in lactating rabbit does.

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The aim of the experiment was to measure an eventual "buck effect" on receptivity, fertility, kindling rate and prolificacy of New Zealand White multiparous lactating rabbit does that were 10 days *post partum* artificially inseminated (AI) with fresh pooled semen in three repetitions (n=549). The adult males were introduced four days prior to each AI into cages which had been left empty for them when the females were placed in before delivery. The series of animals in the row of cages was 7 does, 2 bucks, 14 does, 2 bucks, 7 does, respectively, so, there were 7 does at different distances on either side of the bucks. Each female was evaluated for heat according to the colour and turgidity of vulva (swollen and red or purple were regarded as receptive) when the bucks were introduced and on the day of insemination. One third of the females were also checked on each of the three days prior to AI. Fertility rate was calculated on the result of abdominal palpation on 14th day after AI.

Sixty six percent of the does were receptive when the males were introduced. Receptivity decreased on the following days and the ratio of does receptive on the day of AI was 7% lower ($P<0.05$) than four days earlier. It would probably be incorrect to conclude that placing males close to lactating females has a disadvantageous influence on receptivity on the subsequent days. The operation of receptivity detection (i.e. picking up the female and manually examining the vulva) could be detrimental through the manipulation of the doe, but this hypothesis requires verification in further, targeted experiments. The distance between the bucks and does did not influence the receptivity on any day. It also did not have a significant impact on the fertility (64 to 78%), kindling rate (53 to 66%) or total birth litter size (7.6 to 8.8), although females housed in the neighbour cages of the bucks produced numerically the largest litters. The manipulation involved in checking the state of the vulva for receptivity did not affect the performance of does. The importance of receptivity on the day of AI is proven by the fact that kindling rate was 20% higher in the females that were in oestrus on the day of AI and they produced significantly one-kit larger litters as well.

To summarize, it was concluded that receptivity, kindling rate and litter size were not influenced either by placing males close to lactating does four days prior to AI or by keeping different distances between bucks and females. Even if literature data suggest that the presence of males improves the reproductive performance of nulliparous rabbits, this effect seems not to emerge in the case of lactating does inseminated 10 days after parturition.

Addresses are those of the only first authors

Average useful lifetime in reproduction herd of rabbits.

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The aim of the study was to examine the intensity of breeding of the females of two rabbit breeds (New Zealand White - NZW, and Californian - CAL) in a reproduction farm. The lifetime fertility, relationships and inbreeding were analysed.

From the files available at the farm the identification of the female, litter size at birth and at weaning, and the frequency of matings was determined. The research was carried out on 106 CAL and 41 NZW females with the total number of litters being 452 and 149 respectively.
As the result of the study the following was concluded: CAL females were bred for the first time at the age of 7-8 months, and NZW females at the age of 6-7 months. The maximum number of litters during the productive lifetime of the female was 10 (CAL) or 8 (NZW). However, most of the females gave not more than 3 litters (87% CAL females and 90% NZW females). Average lifetime performance, measured as the number of born/weaned progeny, was 27/25 (CAL) and 28/25 (NZW). The average breeding period (from the first mating to the last litter) was about 13 months, and the total lifetime at the farm averaged almost 2 years. The time from birth to weaning was 60 days on average. The mean litter size at birth was about 6 progeny and this trait was very variable. The rearing effectiveness (number of progeny weaned / number of progeny born x 100%) averaged about 90%. Phenotypic correlations between the size of birth (origin) litter of the female and the size of any of her first three litters were significant but low (CAL).
The analysis of inbreeding and relationships revealed that the average relationship coefficient did not exceed 15% for CAL females, and ranged from 21% to 25% for NZW females. In single cases, inbred animals were detected. For CAL and NZW breeds the contrubution of individual parents (both males and females) to the base herd proved very variable.

The effect of birth weight, milk supply and feeding method on growth in rabbits.

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There is a pronounced impact of newborn weight, milk intake per kit and feed consumption after weaning on the performance of suckling and growing rabbits and these factors are generally synergetic. In a three-factorial experiment, the effect of birth weight (small, medium, large), milk supply (nursing by one or two does) and feeding shedule after weaning (ad libitum or restricted) were examined until the age of 13 weeks in order to evaluate the influence of the nutrient supply at different ages (in prenatal life, at suckling and after weaning) altogether and separately.
120 Pannon White rabbits were housed in a closed building, in wire net flat-deck cages with 16h daily lighting period. Some of the does kindled on the 31st day, the others were treated with oxytocin to promote delivery and after the first suckling the nest boxes were closed. In the next morning (before suckling) the new born rabbits were individually marked and divided into three groups according to their weight (small = 35-45 g, medium = 53- 58 g, large = 65-70 g). Each litter contained 8 kits. One half of the 120 kits were nursed by one doe, while the other half by two mothers. After weaning at 21 days of age, each group was halved again, and the rabbits were fed ad libitum or in a restricted way. The daily feeding access was 10 hours between 3-11 weeks, and 9 hours between 11-13 weeks, which corresponded to about 85-90% of the ad libitum food intake.
All of the three factors significantly influenced the weight gain, body weight, feed consumption and feed conversion. Between 3 to 6 weeks of age, in rabbits of small birth weight nursed by one doe and fed restricted and those of large weight, nursed by two does and fed ad libitum, the daily weight gain were 31.2 and 46.3 g, the daily feed consumption 54.8 and 83.6 g, and the feed conversion 1.75 and 1.8 g/g, respectively. Between the age of 6 and 11 weeks, in order of the two groups these data were 36.3 and 51.8 g, 107 and 160 g, and 2.94 and 3.09 g/g, respectively.

Selection for the body fat content of the rabbits using the TOBEC method.

1. Effect of the selection on some reproductive traits of rabbit does.

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In this experiment Pannon White growing rabbits of average ± 1 S.D. live weight at 10 weeks and of average ± 1 S.D. daily weight gain between 6 and 10 weeks of age were chosen from the experimental stock of the University of Kaposvár and their fat content was determined with an EM-SCAN SA-3152 type Small Animal Body Composition Analyser (by means of the TOBEC method). Based on the fat content determined the best and worst 16% of the does and the best and worst 8% of the bucks were chosen and mated with each other (fatty doe with fatty buck and lean doe with lean buck).
It was found that the conception rate was significantly higher and the number of inseminations needed for the second kindling significantly lower in the case of fatty rabbits. An important, but not significant difference was observed in the case of total litter size at birth, which decreased in the case of live born litter size. This

reason was the significantly higher ratio of the dead born kits in the case of non-fatty rabbits. Due to the higher ratio of total litter loss and suckling mortality in the case of fatty rabbits the litter size at 21 days differed notably, but not significantly again. In the litter weight no significant differences were observed at birth and 21 days.
As a conclusion of this work it was established that the TOBEC method seems to be useful for the selection on body fat content of the rabbits and the body fat content has an important effect on some reproductive traits of the rabbits.

Selection for the body fat content of the rabbits using the TOBEC method.

2. Effect of the selection on the body composition of growing rabbits.

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In this experiment Pannon White growing rabbits of average ± 1 S.D. live weight at 10 weeks and of average ± 1 S.D. daily weight gain between 6 and 10 weeks of age were chosen from the experimental stock of the University of Kaposvár and their fat content was determined with an EM-SCAN Sa-3152 type Small Animal Body Composition Analyser (by means of the TOBEC method). Based on the fat content determined the best and worst 16% of the does and the best and worst 8% of the bucks were chosen and mated with each other (fatty doe with fatty buck and lean doe with lean buck). The body fat content of the offsprings in the f_1 generation was determined at 10 weeks of age by means of the TOBEC method and rabbits with an average (average ± 1 S.D.) fat content were slaughtered immediately after the examinations in both group (n=22 in the fatty and n=20 in the non-fatty group). During the slaughter procedure the weight of the scapular and abdominal fat was determined and its ratio to the live weight calculated.
As a result it was found that the fat content estimated and the ratio of scapular and abdominal fat to the live weight calculated differed significantly ($p<0.05$) from each other in the two experimental groups. The estimated fat content was 42% higher in the offsprings of fatty as in the offsprings of non-fatty rabbits. The differences in the ratio of the scapular and abdominal fat content to the live weight were 26% and 51%, respectively. Based on the fat content estimated the animals slaughtered could be classified 78.6% correctly with the help of the discriminant analysis.
As a conclusion of this work, it was established that the TOBEC method seems to be useful for the selection on body fat content of the rabbits. But, it is necessary to mention, that these results are from a very early stage of a long experimental procedure and therefore further examinations are needed to clarify the exact effect of the selection on the body composition of the rabbits.

Genetic parameters for digestive tract traits in rabbits.

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The material used for the research comprised 206 rabbits of two breeds: New Zealand White (NZW) and Tan, as well as their backcrossings. The animals were slaughtered at the age of 70 or 140 days and, afterwards, the following parts of the digestive duct were examined: stomach (height, diameter at the cardia, the greatest diameter of stomach body, diameter of the pyloric part); duodenum (length, diameter of the beginning part, diameter of the end part); jejunum and ileum length; diameter of the ileum 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); cecum and colon length; diameter of the colic ampule; diameter of the end part of the sigmoid colon; length of the sternum, length of the abdomen and the sum of the last two lengths.
Before estimating the genetic parameters, the analysis of variance was performed, with the following effects taken into account: sex, genetic group, age group and all possible interactions among them. The estimating of the genetic parameters was done with the use of MTDFREML method. The heritability coefficients ranged from 0,10 to 0,77. The highest estimated genetic correlation coefficients were among stomach traits.

Effect of increased supplements of vitamins, macro- and microelements on milk production of does.

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The aim of the present experiment was to determine the effect of increased supplements of vitamins, macro-

and microelements on milk and reproductive performance of does mated during lactation. 60 New Zealand White rabbits of the foundation herd and all their offspring were used in the experiment. Each feeding group consisted of 15 does:

- group A (control) - fed a standard complete pelleted feed,
- group B – fed the control feed with a 50% higher proportion of vitamin supplement,
- group C – fed the control feed with a 50% higher proportion of mineral supplement,
- group D – fed the control feed with a 50% higher proportion of vitamin and mineral supplements.

During the studies, milk samples were taken in three successive lactations from each group at 3, 5, 10 and 20 days after kindling to analyze vitamins A and E, calcium, zinc, phosphorus and iron (samples from particular days were combined for analysis). 5 litters of 8 rabbits each were taken from does of each group in the third breeding cycle and fattened until 90 days of age to analyse daily weight gains and feed conversion per 1 kg weight gain.

The highest average content in milk was observed in groups D (1573.3 IU/100 ml) and B (1422.4 IU/100 ml) for vitamin A and similarly in groups D (1025.4 mcg/100 ml) and B (836.8 mcg/100 ml) for vitamin E. Increased supplements of macro- and microelements in feed also made their content in milk higher. In groups C and D, the contents of calcium, zinc, phosphorus and iron were much higher than in groups A and B. The best parameters of fattening performance were achieved in group D, where the proportion of mineral-vitamin supplement was increased by 50%. The body weight of rabbits at 35 days of age was an average of 872.2 g in group A and 940.7 g in group D. These values are significantly different, just as were the body weights of rabbits at 90 days of age. Group D was characterized by the highest daily weight gains and the lowest feed intake per 1 kg weight gain. The increased supplementation of vitamins and macro- and microelements in the feed of nursing and at the same time pregnant does helped to maintain the high reproductive and milk performance of does, leading to decreased rearing mortality of young rabbits and to improved parameters of slaughter material production profitability.

Genetic parameters for meat quality traits in rabbits.

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The study was performed on 340 rabbits of White New Zealand (WNZ) and Tan breeds and their crossings. The following meat quality traits were measured: pH value at 45 min and 24 h after slaughter (pH-45 and pH-24), absolute and relative change (decrease) in pH value (AC-pH and RC-pH) water, protein and fat content (%), water holding capacity (%), thermal leakage (%), lightness (%), saturation and tone of the colour, and the overall colour. Before estimating the genetic parameters for the above traits, the analysis of variance was performed to determine the influence of the following effects: sex, genetic group, and their interaction. The heritabilities of the traits and the genetic correlations between them were estimated with the use of the MTDFREML method.

As expected, the values of the heritability coefficients were relatively small: 0.316 for pH-45; 0.143 fpr pH-24; 0.326 forAC-pH; 0.25 for RC-pH; 0.043, 0.056 and 0.012 for water, protein and fat content, respectively; 0.207 for water holding capacity; 0.006 for thermal leakage; 0.003 for colour lightness; 0.242 for colour saturation; 0.5 for colour tone; and 0.001 for overall colour.

SECTION ON NUTRITION

The lysosomal enzyme activity in some organs of rabbits on different protein diets.

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The experiment was performed with 12 randomized New Zealand male rabbits at the age of 65 days and live weight 2.0 - 2.5 kg. The animals were divided into two groups (A, B), 6 animals in each group. Group A was fed from the weaning age (35 days) a feed mixture containing 15 % protein, 2.9 % fat and 14 % fibre. Animals in group B of the same age were fed a feed containing 19.0 % protein, 3.2 % fat and 15 % fibre. The animals were slaughtered after 30 days feeding the diets. Samples were taken from liver, kidneys, spleen and heart. In samples were assessed the activities of acid phosphatase, N-acetyl-ß-glucosamidase, ß-glucuronidase, đ-galactosidase, đ-mannosidase, alanyl aminopeptidase, arginyl aminopeptidase, lysosomal arylesterase and cathepsin D.

Higher values in activities were observed in tissues of liver and kidneys from animals fed the feed with higher proportion of proteins.

SECTION ON ETHOLOGY, HOUSING AND WELFARE

Investigations on doe-litter-relationship in domestic rabbits under different housing conditions.

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Doe-litter-relationship was analysed in does with litters of different breeds. Rabbits were kept under different housing conditions. One buck and two does were housed in a free range area (150 m^2) with artificial nest boxes. The other does were kept singly in traditional concrete cages and in get-away-cages of different size and structure (concrete cages: single, double width resp. with or without elevated resting place; get-away-cages: single, double, triple width resp. with or without curtain or tunnel at entry to nest box). Continuous video recordings took place by infrared video technique and time lapse recorder over 24 hours at least on two consecutive days per suckling week. Nest visits of the doe and nursing attempts of the kits were analysed.

On average 17.0 nursing attempts in 24 hours were found in kits kept in unstructured concrete cages. Number of nursing attempts was significantly lower (10.9; $p < 0.05$) in kits housed in structured concrete cages. Kits kept in unstructured get-away-cages showed a higher frequency of nursing attempts (20.1 in 24 hours) than those housed in structured cages (9.0; $p < 0.05$). Kits kept in free range area showed very rare and successless nursing attempts. Domestic rabbit does housed in free range area realized on average 2.1 nest visits in 24 hours with decreasing tendency from the first to the fourth nursing week. Visits mostly took place from dusk to dawn and around nursing event. Does kept in unstructured concrete cages visited the nest significantly more frequently (5.7 visits in 24 hours) than control does in structured cages (2.6 in 24 hours). A tendency of decreasing frequency of nest visits with increasing size of get-away-cages and with availability of structure was observed.

Some observation on behaviour of nursing does.

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The experiments have been done with Pannon White rabbits. The aim of the experiments was to examine the nursing behaviour of does under different nursing methods (free, once a day, alternating both) using 16L:8D lighting period. A continuous video recording with infrared video technique and time lapse recorder over 24 hours a day was used. The experimental groups were :

- FF: Free nursing between parturition and day 16
- FC: Free nursing between parturition and day 9 and controlled suckling between day 10 and 16 (8:00 a.m. to 8:30 a.m)
- CF: Controlled suckling between parturition and day 9 and free nursing between day 10 and 16
- 16h: The enter into the nestbox is free during the interval of 16 hours/day (16:00 p.m. to 8:00 a.m.) between parturition and day 16

Between the 1st and 9th day, 74.8 percent of the does nursed once a day and 25.2% of them nursed more then once a day (only in two cases they nursed three times a day). The same values were 78.4 percent and 21.6 percent between the 10th and 16th day. Only in the CF group, a higher frequency in the number of the daily nursing was observed (36.1% of all cases). The duration of daily nursing was decreased during the nursing period. The duration of one nursing event a day was at the end shorter than the duration of the first and the second suckling of does nursed twice a day. Between the 1st and 9th day in the FF group 65.2% of does nursed in the dark period (between 9 p.m. and 5 a.m.). In the light period, 18.5% of the does nursed between 5 a.m. and 9 a.m.. Between the 10th and 16th day 84.6% of the does nursed in the dark period. At the beginning of the light period (between 5 a.m. and 9 a.m.) the proportion of the nursing was decreased to 7.7 percent. In the CF group 39.2% of the does nursed between 5 a.m. and 9 a.m. after the 10th day. In the dark period 21.6 and 17.7% of nursing events were between 9 p.m. and 1 a.m.and between 1 a.m. and 5 a.m respectively In the 16h group, the nursing events were most frequently in the first hour after opening the door between cage and nest box (4 p.m. to 5 p.m.); 17 % between 1st and 9th and 25 % of all nursings between 10th and 16th day. It was noticed that most of the does (34%) nursed between 1 a.m. and 5 a.m.. During the other periods of the day the nursing was shared uniformly.

How the removal of the nest box affects the behaviour and physiology of rabbit does and the mortality and weight gain of their kits.

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For this study 30 breeding does (ZIKA) were randomly submitted to one of three groups of 10 does with different nest access regimens. In the first group (F), the does had free access to the nest box throughout 24 hours. In the second group (M), the nest was closed by a slide and opened each day at 8 a.m. for 15 minutes. In the third group (O) the nestbox got removed and stored at a different place within the same room and brought to the cage each day at 8 a.m. for 15 minutes. In the conditions M and O the nest access stayed controlled for 15 days after birth. From day 15 the nest access was free. The treatment to which a doe was allocated was the same for the whole study. The does were housed in individual cages (0.6 x 0.9 x 0.6 m) with slatted floor, raised shelf, wooden gnawing stick, straw rack and feed trough. Primiparous does were naturally inseminated at 112 - 126 days of age, multiparous does 11 days after parturition. The kits were weaned at the age of 35 days. The study lasted for three litters. Data shown here concerns the second litter. The does' behaviour was recorded on days 2, 5 and 9 post partum with time-lapsevideo. Data evaluated concerned the time, duration, frequency and kind of nest occupation behaviour over 24 hours (all event sampling) and the does' activity each 10 minutes (scan sampling). To obtain some information about corticosteron(Is there such a word? Maybe corticosteriod?) and leucocyte levels blood samples were taken on day 3, 10 and 17 after parturition. The nests were checked daily; dead kits were removed and sent to the animal hospital of Zurich for the determination of the cause of death. The kits were weighed on days 0, 15 and 35.

The frequency of nest occupation shows a clear difference among the three conditions with the most nest controls in F and the least in O. No difference was found among the leucocyte levels. The corticosteron data are not yet available. No significant difference was found among the mortality during the first 15 days (F: 0%, M: 1.2 %, O: 6.4%). The mortality from day 16 to weaning showed no significant differences (F: 1.7%, M: 15.3%, O: 5.1%), the highest rate being found in M, due to digestive disorders. There was a significant difference in the weight development of the kits. In F kits had a significant higher weight at weaning than those from M.

The preference of fattening rabbits for perforated plastic floor and deep litter under different ambient temperatures.

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Choice experiments with fattening rabbits on litter have shown a significant preference for ambient temperatures of 15° versus 20 and 25°C. When the temperature was lowered from 15 to 10°C there was still a tendency of preference for the colder environment, though the difference was less pronounced. It is known that the preference for ambient temperatures differs in response to the floor type. Floor types with low temperature conductance may be avoided for the problems of the rabbits to dissipate metabolic heat. The opposite tendency is expected under low temperature, where the animals may suffer from excess heat loss, when they are kept on perforated floor. The present experiments were conducted to determine the threshold temperature where the preference for deep litter and perforated plastic floor changes.

The choice experiments were carried out in two cage blocks of 4 compartments each. Each experimental group had access to two adjacent compartments through an opening in the side wall. One of each compartments had a deep litter floor (15 cm dust-free wood shavings) and the other floor consisted of perforated plastic. A infrared video camera was fitted on top of one of each combined compartments. The animals activity in each compartment was recorded continuously by passive infrared sensors. Feed (standard rabbit grower pellets) and water were given ad libitum on both floor types. Urine and faeces were collected on a manure belt underneath the perforated floor. Manure and wet litter were removed daily. The test compartments were located in a climatic chamber were the ambient temperature could be programmed from 5 to 30°C. Two experiments have been conducted. 12 weaned rabbits (ZIKA) were used in experiment 1. Four choice units each, comprising the two connected compartments, were stocked with two rabbits, the other four with one rabbit. The temperature was programmed in alternating phases, starting from 20°C and fluctuating between 5 and 30°C. The temperature was kept constant for 24 hours on the starting (20°) level and the highest (30°C) and lowest (5°C) level. This procedure was replicated 3 times using different animals. The same equipment and breed was used in experiment two. The temperature programme was modified in so far as the experimental

groups were subject to two consecutive cycles from 5 to 30°C, and all rabbits were tested individually. In response to floor type and temperature phase the following traits were recorded: food and water intake, activity as measured by the infrared sensors, time spent active and resting and total time spent on each floor by video-taping.
The rabbits changed compartments very often. There was no obvious difference in floor choice among individually housed rabbits and groups of two. There was a general preference for deep litter for feed intake, and the preference changed towards perforated plastic only when the temperature was raised above 20°C. The automatic activity records and the visually observed data for activity and resting showed that the rabbits preferred the deep litter over a wide range of low and moderate temperature, and the preference changed towards perforated plastic floor when the temperature was above 20°C.

Resting and activity behaviour in domestic rabbits in dependence on keeping conditions and day time.

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Behaviour of does with litters was recorded by infrared video technique and time lapse recorder during at least two days per nursing week. Domestic rabbits of different breeds were housed under different conditions. The reference housing system was a 150 m^2 sized free range area with artificial nest boxes where one buck, two does and their offspringwere kept at the same time. Other does were singly housed in traditional concrete cages with straw as litter material or in get-away-cages with slatted floor of different size and structure (concrete cages: single, double width resp. with or without elevated resting place for doe; get-away-cages: single, double, triple width resp. with or without curtain or tunnel at entry to nest box).
Only small differences were found between does kept in unstructured and structured concrete cages considering ratio between activity (50.9, 51.8 % respectively in 24 hr) and resting behaviour. This is in agreement with the findings of domestic rabbits housed in free range area (51.7 % activity). Does kept in structured concrete cages used the elevated seat and the larger space allowance. They spent 51.0 % of the lying time and 68.5 % of the crouching time in the opposite part of the cage as their kits or on elevated resting place. Only non significant differences occurred in rabbit does housed in structured or unstructured cages related to total amount of activity. Percentage of lying was increased and percentage of crouching was decreased with increasing size of get-away-cages both in structured and unstructured cages. The elevated seat was used by does in unstructured cages significantly more frequently (43.3 to 71.0 % of total lying) than by control does in structured cages (38.5 to 64.4 %). Percentage of use of the elevated resting place by does rose with the passage of nursing period: 38.0 %, 55.6 % respectively in the first nursing week to 60.8 %; 61.7 % respectively during the fourth nursing week. So, nursing does kept in cages with elevated seat have better possibility to get away from kits. This can be positively assessed under the aspects of animal welfare.

SECTION ON PRODUCTS AND PRODUCT QUALITY

Effect of slaughter age and sex of fattening rabbits housed in pens on dressing percentage.

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Two hundred and twenty seven ZIKA young rabbits were sex separated at 35 days of age and housed in groups of 11 to 16 animals. They were fattened and slaughtered at the age of 8, 10 or 12 weeks. In addition to fattening performance data, body weight alive and after slaughtering (warm) and giblet weight were measured. The weight of the body fraction blood/fur/head/paw (BFKP) was calculated. The investigation focused on the sex effect in group management and body weight and age effects on these traits.
A distinct sex by age interaction was detected. At the higher slaughter age does (alive) were significantly heavier than bucks which was partly due to higher giblet weight. Age and body weight alive significantly influenced dressing percentage and BFKP percentage. Dressing percentage was more affected by age in contrast to BFKP percentage, which was hardly affected, by age. Variance of giblet weight was significantly affected by both factors.

The fattening of rabbits in pens : effects of housing and gnawing material on performance level and carcass quality.

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Fatteners housed in conventional wire cages are restricted in their natural locomotion pattern as hopping, running and raising. Also their social behaviour and gnawing possibilities are very limited. In order to overcome these limitations and to enrich the cages, two series of trials were performed to compare the performances of fatteners housed in pens (with or without gnawing material) with conventional cage fattening. In total 816 weanlings (29d old) were used for the 7 weeks fattening trial and 36 of them were slaughtered to evaluate the carcass quality and colour. The pens (30 rabbits/pen) of 1.9 m^2 had floor netting and walls of 60-cm height and the same stocking density (15.5 rabbits/m^2) was used as in the conventional cages (4 rabbits/cage). The following treatments were compared: pens without enrichment (PC), pens with a straw hopper (SH), pens with a wooden stick (WS) and fattening in small wire cages (controls).

Fatteners housed in pens showed a significant lower daily weight gain (-5.2%) and a comparable feed conversion at 11 weeks of age. Cage enrichment did not effect the performances and mortality but aggressiveness was only observed in some pens without enrichment. The intake of straw increased progressively from 2.5 g/d between 29 and 43 d of age till 4.86 g/d during the last fattening week. Although rabbits gnawed extensively on the wooden sticks, the intake was low and increased from 0.07 g/day till 0.32 g/d during the last week. Because of the large losses of straw and the corresponding problems with the evacuation of the droppings, a wooden stick seems to be more convenient to combine the needs for gnawing material and optimal hygenic conditions. Due to some sanitary problems (enterocolitis), the overall rate of mortality and dwarf growers was rather high, 19.7% (controls), 21.7% (PC), 20.8% (SH) and 21.7% (WS), respectively. Slaughter yield at 78 days of age was not significantly affected by housing or enrichment material. Rabbits housed in small wire cages tended to have a higher liver weight. Carcass colour measurements on the back and the hind leg as well as on the LD muscle revealed a more intense red coloration (lower L-value) for rabbits housed in pens.

Quality of rabbit meat under the influence of various deepfreezing and thawing temperatures.

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100 grey and ZIKA-hybrid rabbits were slaughtered in the age of 84 days, in order to survey the effect of various deep-freezing and thawing temperatures related to the meat quality of rabbits. 40 carcasses were deep-frozen at –20°C in a refrigerator. Other 40 carcasses were shockfrosted at –40°C, which were stored after shockfrosting at –20°C until the survey of the meat quality began. Fresh, not frozen rabbits were examined 24 hours after slaughter. 20 carcasses of each group were thawed at 5°C, the other 20 of each group at 19°C and the total carcasses were held at 5°C in order to survey the quality of their meat.Clear differences were found between the frozen and fresh carcasses in the characteristics of electrical conductivity, water holding capacity, grilling loss, shear force and color values L and b. The values of the fresh rabbit meat in those characteristics were better than the values of the frozen carcasses. The shockfrosting had a positive influence upon the grilling loss. The grilling loss was nearly 2% less by shockfrosting than by refrigerating. There were no significant effects of deep-freezing nor thawing temperature on all other measured characteristics of meat quality.

The contents of heavy metals (cadmium, lead, nickel) in muscles, liver and kidneys of young meat rabbits raised on small family farms in low polluted region of South-Eastern Poland.

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Rabbit meat is a very valuable product for human consumption. In Poland many family meat rabbit farms are located in unpolluted regions and tourist areas. The region of Beskid Niski Mountains (former Krosno voivodship) is located in South-Eastern Poland and it is one of the least polluted areas in the country. Nevertheless, due to human activities the presence of pollutants may often be found in regions located far away from original pollution centers. Heavy metals in particular are recognized as the most dangerous compounds for human and animal health. Since 1990 a

rapid growth of motorization is being observed and started to play a vital part in environmental degradation in Poland. In the research the level of cadmium, lead and nickel in muscles, liver and kidneys of young meat rabbits raised on small family farms in Beskid Niski region was measured.
As the results of the research we have found that kidneys are the most liable organ for bio-accumulation, especially for cadmium. The accumulation of each heavy metal in muscle was very low, therefore rabbit meat can be recommended for human consumption. In all tissues nickel accumulates least of all. The use of rapid motorization and heavy industry processes have a significant influence on contents of cadmium and lead in the liver and kidneys of young rabbits, even in regions without local heavy industry.

Investigation of fatty acid metabolism under physical load by means of NMR spectroscopy and gas chromatography on meat type rabbits.

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In three repetitions (four weeks each) Pannon white rabbits were trained on a motor driven "treadmill" to follow the changes of the fatty acid concentrations and relaxometric parameters of different muscles (m. *Longissimus dorsi*, m. *Quadriceps femoris*, m. *Soleus*) and the alterations of the membrane composition of red blood cells. Gas chromatography and NMR spectroscopy were applied to investigate the fatty acid composition and relaxometric properties to the samples.
The muscles of the hind leg (m. QF and m. S.) show a significant increase in the fast components of the T2 relaxation times, while water content and T1 times were unchanged. The m. LD was not significantly affected. Regarding the fatty acids, C 16:0 shows a decrease, C 18:0 and C 20:4 show significant level increases in m. LD and m. QF. Red blood cell ghosts' fatty acids were not affected by the low level training. This typical changes obtained may be more marked, if a high physical load can be achieved.

Carcass value of young rabbits of different fattened hybrids.

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From two investigations with young rabbits of the fattened hybrids Zika and Hyla, as well as the pure breed White New Zealander and a crossbreed "Deutsche Riesen" x (Russian x White New Zealander), both sexes, the carcass value was recorded and compared with each other between the hybrids (n = 4 x 36). The fattening period began in the age of 28 days and lasted, dependent on the hybrid, from 8.5 to 9.3 and from 10 to 14 weeks respectively. After slaughtering the carcasses were frozen. After a storage period of 5 to 8 weeks at -24°C the carcasses were thawed and subsequently investigated in the laboratory. Thereby both the quantitative data of the carcass as well as the qualitative characteristics of the meat were recorded.
The investigations led to following results: The thigh percentage was not subject to the influence of the breed, on the other hand there was an influence at the joints back, belly and fore. The meat percentage of the joints thigh and back was dependent on the breed. The meat condition (pH - value, colour, water binding capacity, objective tenderness) of the thigh and back meat was influenced by the breeds. At the sensory characteristics of the thigh meat there were differences between the breeds, namely the fattened hybrids achieved a better assessment as the pure breed rabbits and the crossbreeds. The chemical composition of the thigh meat showed slight differences between the hybrids.

SECTION ON DISEASES AND DISEASE PROPHYLAXIS

Sublimation of tannic additives to diet of fattening rabbit, to reduce mortality after weaning.

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The reason for this survey was to inquire if an addition of willowbark to the fattening diet would have a positive effect on the often appearing diarrhea and the resulting mortality of weanling rabbits. Six trials were performed. To begin, two trials for assessing acceptance with 18 animals in each group were made; one trial with different doses of oakbark and another trial with different doses of willowbark. It was found , that both substances were accepted in high doses.
The first main trial, with 710 animals altogether, was made in two groups, one group with willowbark additive and one control group. Both groups were fed the same base ration, but to the food of the willowbark group was added 2.5% willowbark. There were no differences in the fattening weights. The differences in the mortalities were very significant (30% mortality in control group, 12% in the willowbark group). The second main trial was the same as the first but with a number of 200 animals altogether. The results were seen to be comparable with that of the first trial. The third main trial was structured in the same fashion as the first and second. It took place on another farm and therefore under other environmental conditions. In this trial no significant differences in fattening weights of the 240 animals were found, but the mortalities of the two groups did again show significant differences (43% mortality in control group, 36% in willowbark group). The fourth main trial took place on the same farm as the first and second. Therein 200 animals altogether took part. The experimental group were given food with 0.4% of a tannin concentrate (*Farmatan*) added. The control group again received the basic ration. The fattening weights of the tannin group have been about 80 g higher than that of the control group (significantly higher). The mortality did not differ significantly; the mortality of the control group was 9%, the mortality of the tannin group was 4%.

Diagnostic findings in rabbits with enterocolitis

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During its first outbreak in rabbit farms the enterocolitis presented itself as an infectious and transmissible paralysis of the gut, as documented by transmission experiments and graphs showing the movement of the smooth muscles of the gut. In small rabbitries we still find the same form after four years, while in large farms the findings have become more variable.
Pathological findings in 828 animals of Italian farms prevalently were diarrhea and catarrhalic enterotyphlitis (85%), while constipation was present only in 17% of the samples. Histological findings were edema of the intestinal wall to some degree; loss of the epithelium, strongest in weaned rabbits; infiltration with leucocytes already in suckling rabbits; and bacterial adhesion overall in suckling animals. Pathological results during the first outbreak and in hobby farms show a different picture: blue colour of the meat, mucoid enteritis and constipation, swelling of lymph nodes, blood store in the organs, in adult animals often pleural and peritoneal exudate. Histological findings were: increase in number and size of intestinal glands, loss of epithelium or its proliferation, and in advanced stadium necrotic lymphocytes.
Microbiological findings in the Italian farms report the most relevant agents of enteritis: *E.coli* strains were isolated from 52 to 75% and increased with the age of the animal, but only 44 to 17% EPEC. Bacterioscopic examinations showed the presence of *C.spiroforme* in up to 70% of the weaned rabbits and 30% of the females. In our samples from German farms *C.spiroforme* was seen on 70% of the slides during the first year, but in the following years other Clostridiae predominated. We isolated *C.perfringens* type A, *C.spiroforme*, *C.sordelli*, *C.tertium* and *C.novi*. In the small rabbitries strains of Clostridium sp. were often the only bacterial agents, indicating that enterobacteria are not essential in mucoid enteritis. It indicates also that M.E. is a toxin dependent paralysis of the gut. In trying to arrive from the toxin to the agent it is known that toxins with similar effects (i.e. ADP-ribosyltransferases which modify actin) are released by several clostridium species.

Prevention of disease through feeding

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In the first weeks of life the morbidity and mortality rate among rabbits is extremely high. Very often the animals die from infectious disease of the digestive and/or respiratory system. In this time period the immune system of the young animals does not provide adequate protection. One possible way to influence the course and outcome of infectious diseases is the prophylactic administration of immunostimulating supplements with food to the animals concerned or the use of alternative feed preparations.
The purpose of this study was to evaluate the influence of an oregano-thyme supplement, an echinacea supplement and an alternative feeding preparation with an increased content of crude fibre on several health and performance parameters of rabbits. The study was performed on 106 female rabbits and their offspring, owned by a single breeder.
The results of the study revealed that the two supplements as well as the alternative feeding preparation had a positive influence on some of the measured parameters. All preparations increased the number of offspring per female rabbit and the mean weight of the fattened young rabbits on day 72 post partum compared to the control group. The groups supplemented with echinacea or with oregano-thyme showed higher immune-globulin-G blood levels compared to the control group on day 28 post partum, when the animals were weaned.

Isolation of the causal agents of rhinitis contagiosa in rabbits from the nasal mucosa of show rabbits.

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In a study of isolation of the causal agents of rhinitis contagiosa in rabbits from the nasal mucosa of show rabbits nasal swabs were taken from rabbits in a national show and bacterio- logical tests carried out on the swabs. Amies medium with charcoal was used for sampling and transport of the samples to the bacteriology laboratory. After initial evaluation of the animals, nasal swabs were taken from all 271 rabbits, none of which showed any sign of clinical disease. A second swab was taken from 248 animals 3 days later, just before the end of the show.
Of the 271 swabs examined at the start of the show, 20 were positive for *Bordetella bronchi-septica. Pasteurella multocida* was not isolated from any animals. *Bord. bronchiseptica* was isolated from 57 of the 248 swabs and *Past. multocida* from 5 swabs at the end of the show. There was therefore an increase in the percentage of animals with *Bord. bronchiseptica* from 7.4% to 23% within the show period. There is some evidence for transmission of the pathogen from infected animals to those housed adjacently.
The general stress levels of the animals and the specific conditions of the show could promote a high growth rate of both *Past. multocida* and *Bord. bronchiseptica* in the mucosa, explaining the higher rate of isolation of the pathogens from the swabs taken at the end of the show. On the basis of these results it is recommended that vaccination with a combined vaccine directed at rhinitis contagiosa of rabbits and pasteurellosis be used to minimise the special risk of infection associated with shows.

Investigations on the spread of Salmonellae by show rabbits.

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Salmonellosis is an uncommon disease of rabbits, nevertheless outbreaks of enzootics in commercial rabbitries are well known. Spread of the bacteria by rabbits presented at shows might be possible.
The aim of the study was to outline the presence of carriers among rabbits presented in a national show and to obtain an overview of the incidence of Salmonella infections in North German rabbitries. Fresh feces samples were taken from the animals and examined bacteriologically. Laboratory procedure was done as usual in *Salmonellae* diagnostics using enrichment media and selective agar. 859 out of 5230 animals, which were presented in the show in January 2000, were tested. Selection of candidates was done in such a manner, that at least one rabbit of each race of each breeder/exhibitor was involved in the screening. The screening was repeated in January 2001. 830 out of 4954 rabbits were tested this time.
Salmonella bacteria have not been isolated from any feces sample.
