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ABSTRACTS OF THE 29TH HUNGARIAN CONFERENCE ON RABBIT PRODUCTION

Kaposvár, Hungary, May 31, 2017.

Around 100 participants took part in the 29th Hungarian Conference on Rabbit Production at Kaposvár, organised by the University of Kaposvár, the Hungarian Branch of the WRSA and the Rabbit Production Board. This is the largest and most popular event for rabbit breeders in Hungary. Twelve papers were presented by senior and young scientists. Topics of the papers covered all areas of rabbit production (production, housing and welfare, reproduction, genetics, nutrition, meat quality). Full papers are available from the organiser (matics.zsolt@ke.hu) on request.

SITUATION OF RABBIT PRODUCTION IN HUNGARY IN 2016

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Compared to 2015, purchasing of live rabbits decreased by 16%. Small scale rabbit production provides only 1-2% of the total purchased quantity. There are 55-60 large rabbit farms in Hungary in production, with around 85 000 rabbit does. The contributions of Pannon White, Hycole, Zika, Debreceni White and Castor Rex were 50, 40, 9, 1 and 1%, respectively. In 2016, the 2 Hungarian slaughter houses processed a total of 4 035 500 rabbits; the ratios of Olivia Ltd and Tetrabbit Ltd were 53% and 47%, respectively. Only 1-2% of the total rabbit meat production was sold in supermarkets in Hungary. The main markets for the rabbit meat were Switzerland, Germany and Italy. Because of the crisis and the unfavourable rouble exchange rate, Russian exports decreased and then discontinued. Due to the increase in stocks, rabbit production had decreased dramatically and the price of live rabbit fell from 480-520 HUF/kg (1.5-1.6 euro/kg) to 400-440 HUF/kg (1.3-1.4 euro/kg). The price of commercial feed decreased by 4-6%.

FUTURE PERSPECTIVES FOR RABBIT MEAT PRODUCTION: A REVIEW

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Since the 70s, several technical improvements in rabbit farming have led to a strong evolution of the sector, which has become increasingly intensive and profitable. To ensure maximum performance and optimal heath conditions of the animals, rabbits are typically farmed indoors, with does and bucks housed in individual cages, while fattening rabbits are kept in collective battery cages. The rabbit meat market grew progressively and nowadays world rabbit meat production accounts for a total of roughly 1.6 million tonnes/year. However, rabbit meat accounts for only 1-2% of all meats consumed in the EU, with an average annual consumption of 1.7 kg/inhabitant, thus being considered a niche market. This is because consumption is mainly tradition-linked and restricted to some geographical areas, so market development still remains to be achieved. In addition, European rabbit farms rarely follow a vertical integration system and are generally independent, which represents a weak point in comparison with the poultry sector. This led to low competitiveness of the rabbit market compared to more common meats such

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as poultry. Furthermore, the growing interest of modern consumers in ethical issues related to intensive animal farming and the derived increasing pressure towards better animal welfare conditions will soon require structural changes in rabbit farming to satisfy consumer expectations, while always ensuring product quality. All these aspects are putting further pressure on the already critical status of the rabbit meat sector, including farmers, who will see an increase in the already high production costs and a lowering of productivity, requiring an increase in rabbit meat prices to cover growing costs. However, this will not be enough to guarantee their survival. New strategies should be designed to make rabbit meat an appealing product and effectively re-launch the rabbit meat sector by achieving a greater market share. Consumer attitudes towards rabbit meat quality and expectations when buying a rabbit meat product must be carefully considered, especially now that western consumers are increasingly concerned about the role of foods, including meat, in ensuring and ameliorating their health status, as well as their growing interest in ethical issues related to rabbit production. It will also be necessary to achieve market segmentation by further enhancing the already excellent intrinsic quality of rabbit meat and starting to exploit extrinsic attributes of rabbit meat. To achieve this, it would be necessary to improve the integration of the rabbit value chain, to start applying alternative production systems in accordance with the emerging welfare standards, to develop convenient processed rabbit meat products for different market segments, and to design appropriate marketing and communication strategies. These should focus on promoting rabbit meat consumption among traditional consumers, while also aiming to encourage the rest to purchase wholesome and healthy rabbit meat.

EFFECT OF HIGH AMBIENT TEMPERATURE ON RABBIT PRODUCTION: A REVIEW

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The reason we deal with the issue of high ambient temperature is dual: the first is the challenge of global warming; the second is its effect on rabbit production. According to the Intergovernmental Panel on Climate Change, the forecast is that heat wave events are likely to increase both in number and intensity. The increase in global average surface temperature by 2100 may be between 1.8 and 4.0°C. Rabbit meat production has traditionally been typical of Mediterranean countries located in temperate (France, Spain, Portugal and Italy) and hot climates (mainly North African countries). In addition, in recent decades rabbit production has risen in many developing countries (such as Mexico, Egypt, Nigeria, etc.), most of these countries located in temperate, subtropical and tropical climate areas. One of the major limiting factors for rabbit production is the environmental conditions, especially the ambient temperatures. For this reason, several experiments have focused on evaluating heat stress effects and possible solutions to alleviate their impact on rabbit performance. The aim of this work was to collect and process the data of literature from the last two decades on the effect of ambient temperature on production of rabbit does, bucks and growing rabbits.

EFFECT OF DIVERGENT SELECTION FOR TOTAL BODY FAT CONTENT ON PRODUCTION PERFORMANCE AND CARCASS TRAITS OF GROWING RABBITS

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The aim of the study was to investigate the effect of divergent selection for total body fat content on the performance and carcass traits of growing rabbits. The experiment was conducted at Kaposvár University with Pannon Ka (maternal line) rabbits. Male and female rabbits at 10 wk of age were examined by computer tomography. Fat index was calculated as the estimated total body fat content of the rabbits (cm^3) divided by the body weight (kg). In each generation, the rabbits with the lowest fat indexes (Lean group) and with the highest fat indexes (Fat group) were chosen for future breeding animals. Weaned male rabbits (n=60 Lean and 60 Fat/generations) from the first 4 generations (Gen1, Gen2, Gen3 and Gen4) were housed in wire-mesh cages (3 rabbits/cage) and fed with commercial pellets *ad libitum* from weaning (5 wk) to slaughter (11 wk). There was no significant difference between Lean and Fat rabbits in the body weight at 5 wk in Gen1 and 2. However, in Gen3 Lean rabbits were heavier than Fat rabbits, but in Gen4 Fat rabbits were heavier than Lean rabbits ($P<0.05$). The weight gain and body weight at 11 wk were not affected by the direction of selection. Lean rabbits consumed less feed than Fat rabbits ($P<0.05$) in Gen3 and Gen4 between 5-11 wk. In Gen1, Gen2, Gen3 and Gen4, the Lean group had a better feed conversion ratio than that of the Fat rabbits (3.97 *vs.* 4.20, 3.16 *vs.* 3.29, 3.52 *vs.* 3.72, 3.52 *vs.* 3.79 respectively; $P<0.05$). The ratio of perirenal fat to reference carcass

was significantly higher in Fat than in Lean rabbits in each generations. There was no significant difference in dressing out percentage, but some differences were found in ratio of carcass parts. We may conclude that the divergent selection for total body fat content was effective to modify the feed intake, feed conversion ratio and the ratio of perirenal and scapular fat compared to reference carcass.

EFFECT OF DIVERGENT SELECTION FOR TOTAL BODY FAT CONTENT DETERMINED BY COMPUTER TOMOGRAPHY ON REPRODUCTIVE PERFORMANCE OF RABBIT DOES

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Our hypothesis is that selection for total body fat content is appropriate to improve the condition and production of rabbit does. The experiment was conducted at Kaposvár University with Pannon Ka rabbits (maternal line). Male and female rabbits at 10 wk of age were examined by computer tomography. Fat index was calculated as the estimated total body fat content of the rabbits (cm^3) divided by the body weight (kg). Rabbits with the lowest fat indexes (Lean group) and with the highest fat indexes (Fat group) were chosen for future breeding animals. To form generation 1 (Gen1), 24.6% of male, 34.4% of female rabbits in Lean group and 23.9% of male and 34.4% of female rabbits in Fat group were selected. The percentage of selected rabbits were 50.0% of male, 69.8% of female in Lean group and 50.0% of male and 61.0% of female rabbits in Fat group for generation 2 (Gen2). To form generation 3 (Gen3) 31.5% of male and 33.9% of female rabbits in Lean group and 33.1% of male and 32.6% of female rabbits in Fat group were selected. From the offspring of Gen3 39.3% of male and 52.4% of female rabbits in Lean group and 38.9% of male and 54.8% of female rabbits in Fat group were selected (Gen4). The reproductive performances of the does were examined during the first 4 consecutive reproductive cycles. The selection process did not influence the kindling rate in the first three generations, but in the fourth generation the kindling rate of Fat rabbits was 15% higher ($P<0.001$) than that of the Lean group. The body weight of does after kindling did not differ in generations 1 and 2, but Lean does were heavier than Fat does in generations 3 and 4, by 0.1 and 0.2 kg, respectively ($P<0.05$ and $P<0.001$). The other reproductive traits (litter size and litter weight at 21 and 35 d, kit mortality) were not affected by divergent selection, but the individual weight of kits at 21 and 35 d of Fat group was lower than that of kits from the Lean group in generation 3 ($P<0.01$). We conclude that more generations are necessary to estimate the effectiveness of divergent selection for total body fat content of rabbit does.

FATTY ACID PROFILE OF FOUR MEAT CUTS FROM RABBITS DIVERGENTLY SELECTED FOR THE TOTAL BODY FAT CONTENT

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A population of Pannon Ka (maternal line) rabbits has been divergently selected for high (Fat) and low (Lean) total body fat content throughout 3 generations (I, II, III). At each generation, the dissectible fat was removed from 60 carcasses (30/Lean and 30/Fat) and its content was expressed as percentage of the chilled carcass. At generation III, 4 anatomical cuts belonging to 30 carcasses (15/Lean and 15/Fat) were excised and analysed to determine the fatty acid (FA) profile (n=30 *Longissimus dorsi* muscles; n=30 hind legs, n=30 fore legs; n=30 abdominal walls). Divergent selection was effective in modifying the total dissectible body fat content. Indeed, within each generation, total dissectible fat percentage was higher for the Fat group ($P<0.05$) and, within Fat group, it increased from generation I to III (1.86 *vs.* 2.65% for generations I and III, respectively; $P<0.001$). Regarding the FA profile of the meat, divergent selection modified monounsaturated FA (MUFA) contents and n-6/n-3 ratio ($P<0.05$). Interestingly, the four meat cuts exhibited the same trends, with the Fat group resulting in higher MUFA incidences and a more favourable n-6/n-3 ratio.

USE OF NEAR INFRARED SPECTROSCOPY (NIRS) TO DISCRIMINATE MEAT CUTS FROM RABBITS DIVERGENTLY SELECTED FOR TOTAL BODY FAT CONTENT

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A population of Pannon Ka (maternal line) rabbits has been divergently selected to obtain 2 lines with extreme total body fat content (Fat and Lean) throughout 3 generations (I, II, III). The purposes of the study were to test NIRS ability to predict rabbit meat composition, to discriminate among different rabbit meat cuts, and to classify meat samples according to the 2 divergently selected lines. The proximate composition of 240 meat samples belonging to generations I and III [n=60 abdominal walls (AW); n=60 fore legs (FL); n=60 hind legs (HL) and n=60 *Longissimus dorsi* (LD)] was first assessed by wet chemistry and then estimated by NIRS. Partial least-square regression (PLS) revealed that NIRS excellently predicted moisture and lipids (R^2: 0.87 and 0.97, respectively). PLS discriminant analysis (PLS-DA) showed a high capacity of NIRS for correctly discriminating samples among the 4 meat cuts (AW and FL: 91.7%; HL and LD: 98.3%), but a poor ability to correctly classify samples between Fat and Lean groups (Fat: 35.0%; Lean: 60.8%).

APPLICATION POSSIBILITY OF THE SELECTION INDEX METHOD FOR PANNON KA RABBIT BREED

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The Pannon Ka is a maternal line in the Pannon breeding programme at Kaposvár University, Hungary. In the present study, genetic parameters for the number of kits born alive (NBA) and the litter weight at 21 d of age (LW21) were estimated, and a 2-trait selection index was created in order to modify the selection process of the breed. Phenotypical values were estimated by the performance of previous generations for NBA and LW21 and individual data were collected by measuring the litter weights and collecting the number of kits born alive. NBA and LW21 data were collected from the Pannon Ka does between 1999 and 2016 and the total number of animals was 5627. NBA and LW21 were analysed jointly in a 2-trait animal model which was used to estimate the variance components. The breeding values included fixed effects such as parity of the doe and year and month of kindling. The covariate factors were the number of kits after equalisation and age of the kits at weaning for LW21. The random effects were permanent environmental effect and the additive genetic effect for both traits. The average inbreeding was 5.89%. The estimated heritability for LW21 was 0.1±0.01 and 0.06±0.01 for NBA, and the genetic correlation between the traits was 0.16±0.06, respectively. The created selection index contained the means of the estimated breeding values in 50-50% contribution of the measured traits. Despite the 50-50% weighting, the selection index the NBA showed a stronger correlation (0.98) with the index score than LW21 (0.36), due to its economic importance.

LOCATION AND BEHAVIOUR OF GROUP HOUSED RABBIT DOES IN PENS INCLUDING COMMON AREA AND INDIVIDUAL CAGES (PRELIMINARY RESULT)

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The aim of the experiment was to test a special group housing system, examining the location, aggressive and sexual behaviour of rabbit does in pens which include individual cages and a common area. The experiment was conducted at Kaposvár University with non-pregnant Pannon White rabbit does (n=44). The temperature was 15-18°C, and 16-h daily lighting was applied in the room. The rabbit does consumed commercial pellets *ad libitum* and water was available from nipple drinkers. The 1.83×2.00 m open top pen contained 4 individual cages (0.5×0.91 m), which were connected to the 1.83×1.00 m common area through a 0.25 long and 0.20 wide lockable corridor. The rabbit does were randomly divided into 3 groups. The groups differed only in that the wire-mesh walls of the individual cages were covered or not with plastic sheets. Pen with plastic walls (Plastic Pen, PP, n=16); pen with wire-mesh walls (Wire-mesh Pen, WP, n=12); and pen with partly plastic and wire-mesh walls (Mixed Pen, MP, n=16). At the beginning of the experiment, the does were placed in the closed cages (4 does/pen) individually for 3 d to get used to their own cages. After the adaptation period, the doors of the cages were opened to allow the does to move freely. The experiment lasted for 14 d. 24-h video recordings were made on days 1, 3, 7 and 14 after opening the doors. Location of rabbits was registered every 15 min. The behavioural patterns (fighting, chasing and mating attempts) were observed continuously. The injuries were registered on days 2, 4, 8 and 14. Especially on day 1, rabbit does preferred to stay alone rather than together (PP: 73.8%; WP: 65.4%; MP: 79.5%). Throughout the experimental period, the rabbit does located alone more frequently than together (WP: 53.0%; MP: 66.5%), except in PP (46.0). The majority of does preferred to stay in the individual cages rather than in the common area in WP and MP (65.9 and 71.5%, respectively). In PP, the does located less frequently in the individual cages (47.2%). In WP and MP, more rabbit does

located in their own cages than the expected probability (25%) on all days (total experimental period: PP: 27.8; WP: 31.1; MP: 37.6). Frequencies of all examined behavioural patterns (fighting, chasing and mating attempts) were the highest on day 1 (PP: 118, 323, 262; WP: 48, 179, 179; MP: 121, 128, 148). The least fighting occurred in WP, where does were able to see each other and so were able to avoid aggressive contacts. The frequency of mating attempts was high until the end of the experiment. High frequencies of injured rabbits were observed throughout the experimental period (PP: 37.5%; WP: 16.7%; MP: 50%). We concluded that the main problems (aggressiveness, injuries) of group housing of does were not solved with this system.

MILK POWDER BASED SOLID ADDITIONAL FEEDING OF SUCKLING RABBIT KITS IN EARLY AGE

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The aim of the experiment was to examine the possibility of additional feeding of suckling kits using solid feed based on commercially available milk powder. The experiment was conducted at Kaposvár University with Pannon White rabbits (n=20 does, 180 kits). They were randomly divided into 2 groups after cross fostering (2 d after kindling; 10 does and 90 kits per group). The does were housed in flat deck cages. Controlled nursing was applied until 16 d of lactation. The litters in control group (K) did not receive additional pellets. In group T, the kits were additionally fed with pellets (8 mm of diameter, 20 mm length cylinder shaped pellet) made of milk powder: water in 9:1 weight ratio. At the beginning of the experiment (3 d), 2 pellets were placed into the nest. Later on, the number of pellets was gradually increased to 6 till 15 d. Based on the visual observation and video recording, the kits consumed the additional solid feed. There were no differences in milk consumption, body weight and body weight gain of kits. The additional feeding did not affect kit mortality. Further studies are needed to examine the effect of other components and techniques to improve the additional feed intake and growth of the suckling kits in early age.

NURSING BEHAVIOUR OF RABBIT DOES WHICH WERE NURSED ONCE OR TWICE A DAY (PRELIMINARY RESULTS)

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The nursing behaviour of does which were nursed once or twice a day was examined. Kits were nursed once (8 a.m.; K) or twice (8 a.m. and 4 p.m.; D) a day till 21 d of age. At 16.5 wk of age, rabbits were artificially inseminated and housed in flat deck cages. A 16 h lighting period (6 a.m.-10 p.m.) and free nursing were applied. During the first 2 lactations, does were monitored 24 h/d by infrared cameras, and the distribution and time of nursing events were recorded. The suckling kits' body weight was measured and the weight gain and survival of kits were calculated. Double nursed does (D) nursed their kits more than once within 24 h at almost 65% of total observed days ($P<0.001$), which was more frequent than that of the single nursed group (K: 18.3%). The nursing method of does did not affect the weight gain and survival of the kits, although the body weight of D kits differed significantly from group K at the age of 13 d (+2 g, $P<0.05$). Time of the nursing as a kit could have an effect on the nursing behaviour of the does. In this experiment, only the double nursed does nursed their kits after 4 p.m.. An experiment with a higher number of animals is needed to provide more reliable results.

EXPERIMENTAL RESULTS ON THE BEHAVIOUR AND WELFARE OF RABBITS

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Farmed rabbit welfare mainly depends on the housing conditions. When group size is more than the number of littermates, a higher rate of mortality and injured rabbits are expected. The optimal stocking density is about 40-45 kg rabbits/m^2. Rabbits do not like staying on a deep litter floor. Gnawing sticks are an effective means to reduce aggressiveness (body lesions). Group housing of does often results in chronic stress, aggressiveness, injuries and a higher risk of mortality, and the reproductive performance is lower. For European wild rabbits, living in groups has several negative aspects which are similar to the group housing of domestic rabbit does. Concerning all aspects of housing systems, we may conclude that individual housing of does in enlarged and enriched cages currently best meets the demands of rabbits, farmers and consumers, bearing in mind that the alternatives increase the cost of production.