

ABSTRACTS OF THE “18TH HUNGARY CONFERENCE ON RABBIT PRODUCTION”

KAPOSVÁR, Hungary. May 24, 2006.

About 150 participants took part on the 18th Hungarian Conference on Rabbit Production at Kaposvár, organized by the University of Kaposvár, the Hungarian Branch of the WRSA, the Rabbit Production Board and the Agribrand Europe Hungary Inc. This is the largest and most popular event of the rabbit breeders in Hungary. 34 papers were presented by scientists and PhD students. The abstracts of 30 papers are published in the WRS. The topic of the papers covered all fields of rabbit production (genetics and biotechnology, reproduction and milk production, nutrition and digestive physiology, meat quality, pathology, housing and welfare). Some of the full papers are available at www.atk.u-kaposvar.hu/ertes/nyulasnapok.htm in Hungarian, but the abstracts and table and figure headings are written in English as well.

PRODUCTION

SITUATION OF RABBIT PRODUCTION IN 2005.

KLING J. *Rabbit Production Board, Budapest, Hungary. bacskart@artnet.hu*

In 2005, the total quantity of the Hungarian rabbit production was 13,520 tons in live and 5,310 tons of carcass. The production level increased by 13% between 2004 and 2005. The amount of carcass (fresh + frozen) exported to Italy, Switzerland and Germany was 2,081+113, 1,080+306 and 823+220 tons, respectively. The proportion of rabbits produced in small and large farms was 10 and 90%, respectively. The price of live rabbits (paid by the slaughter houses) was decreased by 8% between 2004 and 2005. Rabbit breeders did not receive any subsidy from the Hungarian government.

CONSUMERS' OPINION ABOUT RABBIT MEAT CONSUMPTION IN BUDAPEST. BODNÁR K.,

WISZLER G. *Univ. of Szeged, College of Agr., Hódmezővásárhely, Hungary. bodnar@mfk.u-szeged.hu*

The aim of the study was to obtain information about the rabbit meat consumption habits of consumers at Budapest. Data were collected by questionnaires (n=543). Rabbit breeders provide a regular self-consumption, and they sell live animals and carcasses to friends, neighbours and also for local markets. 75% of the investigated population has already tasted rabbit meat, but 70% of them eat it only one or two occasions a year. People having negative attitude to rabbit meat are vegetarian or refuse consumption due to emotional reasons. However the most frequent problem is the lack of rabbit meat and rabbit products in the butcher's, so urban citizens, liking rabbit meat can buy it only in not preferred supermarkets. One third part of the people buy living animals or the whole carcasses (8% and 26%) and 46% is looking for different parts of the rabbit. 66% of the consumers would like to buy semi-finished or ready-made products. The habits of rabbit meat processing and cooking is very poor in the Hungarian cuisine, only 14% of the people could list more than 2 rabbit-based meals. The recent price of the rabbit meat seems to be too high, because

almost half of the consumers would not like to pay more for it than the price of broiler chicken. Several possibilities were found, how to improve the rabbit meat consumption in Budapest.

BIOTECHNOLOGY

APPLIED EMBRYOLOGICAL RESEARCH BY BIOTECHNOLOGICAL METHODS IN RABBIT.

GÓCZA E., LEMOS A. P. C., HIRIPI L., BODROGI L., BOGDAN C. V., BŐSZE ZS. *Agricultural Biotechnology Center, Gödöllő, Hungary. elen@abc.hu*

Transgenic rabbits are excellent animal models of diseases and are used as bioreactors for producing recombinant proteins. Unfortunately, the use of transgenic rabbits is limited by the low efficiency of microinjection and the absence of really pluripotent embryonic stem cell lines. The aim of our work is to establish embryonic stem cell (ES cell) lines from rabbit embryos. We developed a method for derivation of rabbit ES like cell line. We could demonstrate short-term cultivation of alkaline phosphatase (AP) positive rabbit ES-like cell lines. Rabbit ES like cells resembled by their growth in tightly packed, flat colonies to human ES cell lines. Rabbit ES like cells showed Oct4, SSEA-1, Nanog, PODLX and CD9 expression. Using primers developed for rabbit LIFR gene we could identify LIFR expression in rabbit ES like colonies. We demonstrated, that rabbit ES like cells could differentiate into beating cardiomyocytes. Towards the aim of creating second-generation transgenic rabbits, we developed a technological background that enables us to create tetraploid rabbit embryos and rabbit chimeras efficiently.

IN VITRO MATURATION OF RABBIT OOCYTES.

POLGÁR ZS.¹, SOMFAI T.¹, ANGELI V.², DINNYÉS A.^{1,3}. ¹*Agricultural Biotech. Center, Gödöllő, Hungary,* ²*Szent István Univ., Fac. Of Veterinary Sci., Budapest, Hungary,* ³*Szent István Univ., Gödöllő, Hungary.* *polgarzs@abc.hu*

The improvement of in vitro maturation (IVM) system could play an important role in rabbit biotechnology. The present study was carried

out to evaluate the effects of different IVM media, shipping and IVM incubation temperatures. Rabbit ovaries were collected in slaughterhouse and transferred in PBS, than the harvested oocytes were matured for 16 h (Lorenzo et al. 1996). Maturation of oocytes was assessed by extrusion of the second polar body. Data were analyzed with t-probe and logistic regression by R program (R Development Core Team, 2004). Significant differences were observed between the maturation rates (matured/total oocytes) of the oocytes collected from ovaries transported at 32 vs. 37°C (N=454; 42,5% vs. N=388; 18,8%, $P < 0,05$). In further experiments two types of IVM media were compared. In one of the groups growth factors (IGF-I (50 ng/ml), EGF (10 ng/ml)) and hormones (hCG (51 NE/ml) and PMSG (51 NE/ml)) were added to the IVM medium, and the other group was not supplemented. The results showed no significant differences between the maturation rates of the two groups (N=416; 31,7% vs. N=426; 31,5%, $P > 0,05$). The IVM has been carried out at two different temperatures (37°C vs. 38,5°C) resulting in significantly different maturation rates (N=350; 26,9% vs. N=392; 35,0%, $P < 0,05$). The results show that shipping of the ovaries at 32°C and IVM of oocytes at 38,5°C were beneficial to achieve high in vitro maturation rates in the rabbit. The project was supported by EU FP6 MEXT-CT-2003-509582, EU FP6 518240, Welcome Trust -070246 and TET CH-28/04 project.

PRODUCTION OF RECOMBINANT PROTEIN IN THE MILK OF TRANSGENIC RABBIT.

BODROGI L.¹, BRANDS R.², RAABEN W.³, SEINEN W.², BARANYI M.¹, FIECHTER D.³, BŐSZE Z.¹. ¹*Agri. Biotech.Center, Gödöllő, Hungary.* ²*IRAS, Univ. of Utrecht, The Netherlands.* ³*AM-Pharma B.V. Bunnik, The Netherlands.* *bodrogil@abc.hu*

Alkaline phosphatase is a promising therapeutic agent in the Gram negative bacterial lipopolysaccharide (LPS) mediated diseases. LPS is dephosphorylated and thereby detoxified by alkaline phosphatase at physiological pH (Poelstra, 1997a and 1997b). In earlier

GENETICS

experiments calf intestinal alkaline phosphatase (CIAP) prevented mice from lethal *E. coli* infection and attenuated LPS toxicity in piglets (Beumer, 2003). More recently, bovine intestinal alkaline phosphatase (BIAP) efficiently attenuated the inflammatory response in a polymicrobial secondary peritonitis mouse model (Van Veen, 2005). APs may be considered as important host defence enzymes and LPS is a natural substrate for APs. In order to test the hypothesis that tissue non-specific alkaline phosphatase (TNAP) treatment might be favourable to other AP's in the prevention of LPS mediated diseases, we created transgenic rabbits producing enzymatically active hTNAP in their milk.

THE RABBIT LEUKEMIA INHIBITORY FACTOR RECEPTOR. LEMOS A.P.C.¹, GÓCZA E.¹, ROGEL-GAILLARD C.², BŐSZE ZS.¹. ¹*Agr. Biotech. Center, Gödöllő, Hungary,* ²*Lab. Mixte INRA-CEA de Radiobiologie et d'Etude du Génome, Jouy en Josas, France.* bosze@abc.hu

Embryonic stem cell markers are very useful in characterising newly established cell lines. The Leukemia inhibitory factor (LIF) and its receptor (LIFR) are essential cytokines involved in blastocyst implantation besides conferring pluripotency to embryonic stem cells (ES). Based on the CLUSTALW alignment of LIFR mRNA of different species (human, mouse, rat), degenerated primers were designed. RNA was isolated from the forming genital ridge of 13.5 days old rabbit embryos. RT-PCR technique was employed to isolate rabbit cDNA. The isolated 526 base pair long fragment based on the sequence comparison showed 85% homology with the mouse, 87% homology with the human and 82% homology with the rat sequence. By the help of this sequence information two rabbit BAC clones harbouring the LIFR gene were isolated.

EFFECT OF DIVERGENT SELECTION BASED ON CT MEASURED HINDLEG MUSCLES ON PRODUCTIVE AND CARCASS TRAITS AS WELL AS ON MEAT QUALITY OF RABBITS. SZENDRŐ ZS., METZGER SZ., ROMVÁRI R., SZABÓ A., LOCSMÁNDI L., PETRÁSI ZS., NAGY I., NAGY Z., BIRÓNÉ NÉMETH E., RADNAI I., MATICS ZS., HORN P. *Univ. of Kaposvár, Hungary.* pohnl@mail.atk.u-kaposvar.hu

Rabbits were divergently selected for muscle content on hind legs, as measured by computerized tomography (CT). Progenies of does and bucks in the first and second generations were compared. Five-week old rabbits were divided into 4 groups: M=progenies of minus selected parents of the first generation (n=71), P= progenies of plus selected parents of the first generation (n=64), MM=progenies of minus selected parents of the second generations (n=25), progenies of the plus selected parents of the second generation (n=57). Forty 10-week old rabbits in the M and P groups and 24 animals in the MM and PP groups were scanned by CT and their muscle content on hind legs was measured. All of these rabbits were slaughtered and the carcasses were divided. In the first generation the productive traits of growing rabbits were similar but in the second generation the feed intake and feed conversion was better in PP than in MM groups (128 vs. 138 g, 2.81 vs. 3.01 g/g, $P<0.001$); body weight and weight gain were similar. Significant differences were found in the first generation: weight of skin, kidneys and scapular fat was higher in M group, while the weight of hind part of carcass was higher in P group. Ratio of fat deposit and intermediate part to reference carcass was higher in M rabbits, while the hind part in the P group. More pronounced differences were found in the second generation: the weight of perirenal fat (29.4 vs. 23.8 g, $P<0.05$) and scapular fat (6.05 vs. 13.0 g, $P<0.001$) was lower, while the weight of the hind part (473 vs. 439 g, $P<0.05$) and hind legs (355 vs. 326 g, $P<0.05$) was higher in PP rabbits. The ratio of gastrointestinal tract to body weight was lower in PP group (16.7 vs. 18.1%, $P<0.05$).

Significantly lower ratio of perirenal fat, scapular fat and fore part of carcass (1.90 vs. 2.40%, $P<0.01$; 0.49 vs. 1.07 g, $P<0.001$, 29.4 vs. 30.1%, $P<0.05$, respectively), while higher ratio of hind part and hind legs to reference carcass (38.2 vs. 36.3%, 28.7 vs. 26.9%, $P<0.001$, respectively) was measured in PP group compared to MM rabbits. Data of the experiment confirm the effectiveness of CT based selection. If the selection criteria is to increase the volume of hindleg muscles, not only the carcass traits increase but the feed intake and feed conversion will be better as well.

EFFECT OF CT BASED DIVERGENT SELECTION ON LIPID PEROXIDE AND GLUTATHIONE STATUS OF SOME TISSUES OF GROWING RABBITS.

MÉZES M.¹, METZGER SZ.², ROMVÁRI R.², LOCSMÁNDI L.², PETRÁSI ZS.², SZABÓ A.², WEBER M.¹, BALOGH K.¹, ERDÉLYI M.¹, SZENDRŐ ZS.². ¹*Szent István Univ., Fac. of Agric. and Environmental Sci., Gödöllő, Hungary.* ²*University of Kaposvár, Kaposvár, Hungary.*
Mezes.Miklos@mkk.szie.hu

Effects of divergent selection on muscle on hind legs by CT method on the lipid peroxide state, as measured by the content of malondialdehyde, also on the glutathione redox system, as measured by the amount of reduced glutathione and activity of glutathione peroxidase activity in different tissues (blood plasma red blood cell haemolysates, liver, spleen and leg muscle homogenate) were investigated in Pannon white rabbits after slaughtering. The results suggest that divergent selection oriented to increase or decrease of the amount of meat on hind legs, as a genetic effect did not affect on the glutathione redox state of the tissues but malondialdehyde content was higher in the plus variant group irrespective of the sex. For that reason the selection decreased the oxidative stability of hind leg meat.

GENETIC PARAMETERS OF CARCASS TRAITS IN PANNON WHITE RABBIT POPULATION.

NAGY I., METZGER SZ., PRINCZ Z., RADNAI I., BÍRÓNÉ NÉMETH E., SZENDRŐ ZS. *Univ of Kaposvár, Hungary.*
nagy@mail.atk.u-kaposvar.hu

Pannon White rabbits' test slaughter results from the Experimental Rabbit Farm of the University of Kaposvár were analysed. The data set was small and varied between 123-392 for the different slaughter traits. Evaluated with animal model (REML) the heritability estimates (\pm s.e.) of the body weight at slaughter, dressing out percentage, thigh muscle volume, *muscle longissimus dorsi* volume, and perirenal fat volume were 0.46 ± 0.07 , 0.35 ± 0.10 , 0.57 ± 0.11 , 0.24 ± 0.12 and 0.20 ± 0.07 , respectively. Size of the random litter effects was small ($0.01-0.14\pm 0.05$). The moderately high heritability of the thigh muscle volume is expected to make efficient selection possible. The estimated genetic correlation coefficients showed high standard errors (s.e.) and the present results are not meaningful. In order to estimate reliable genetic correlation among the carcass traits substantially larger dataset is required.

REPRODUCTION

EFFECT OF REARING METHOD ON BODY WEIGHT AND CONDITION OF DOES AT THE AGE OF FIRST MATING.

SZENDRŐ ZS.¹, GYOVAI M.¹, ROMVÁRI R.¹, SZABÓ A.¹, ANDRÁSSYNE BAKA G.¹, MAERTENS L.², RADNAI I.¹, BÍRÓNÉ NÉMETH E.¹, MATICS ZS.¹. ¹*Univ of Kaposvár, Hungary.* ²*Centre for Agr. Res., Melle, Belgium.* pohnl@mail.atk.u-kaposvar.hu

The effect of birth weight, number of nursing does (one or two), feeding regime (*ad libitum* or restricted) and the age at first mating (15.5 or 18.5 weeks) was examined on body weight and condition of does at the age of first artificial insemination. The condition of rabbits was estimated by computerised tomography, measuring the surface of fat and muscle tissue of whole body (scans were made each 10 mm). According to the data the body weight of does was affected by birth weight (small: 3.27, medium: 3.37 and large: 3.51 kg, $P<0.05$), number of nursing does (one: 3.29, two: 3.52 kg, $P<0.05$), feeding regime (restr.: 3.23, *ad lib*: 3.55 kg, $P<0.05$) and age at first mating (15.5w: 3.32, 18.5w: 3.49 kg, $P<0.05$). Body condition (ratio of fat to muscle pixels) was influenced significantly by

feeding regime (restr: 0.394, *ad lib*: 0.521, $P < 0.05$). A slight difference was observed between groups of small and large birth weight and between rabbits nursed by one or two does but the effect was not significant.

EFFECT OF REARING METHODS ON THE LIFETIME PRODUCTION OF RABBIT DOES.

SZENDRŐ ZS.¹, GYOVAI M.¹, MAERTENS L.², BIRÓNÉ NÉMETH E.¹, RADNAI I.¹, MATICS ZS.¹, NAGY I.¹. ¹Univ of Kaposvár, Hungary. ²Centre for Agr. Res., Melle, Belgium. pohnl@mail.atk.u-kaposvar.hu

The objective of the study was to examine the effect of birth weight (35-45, 53-58 and 65-70g), milk supply (nursing by one or two does), feeding regime (*ad libitum* or restricted = 80-85% of *ad libitum* group) and age at first insemination (15.5 or 18.5 weeks) on the lifetime production of rabbit does. None of the examined factors affected significantly the number of parity, number of kits born total or alive, but the group of rabbits nursed by two does and feed restricted achieved higher production. Compared to the conventional rearing method (nursing by one doe and fed *ad libitum* between weaning and first mating), the group of rabbits nursed by two does and fed restricted till 4 days before the first insemination achieved higher number of litters by 12% (6.0 vs. 6.7), number of total born rabbits by 14% (53.1 vs. 60.3) and number of born alive by 16% (48.9 vs. 56.5).

EFFECT OF VULVA COLOUR AND TURGIDITY ON CONCEPTION RATE AND LITTER SIZE OF RABBIT DOES.

SZENDRŐ ZS.¹, RASHWAN A.A.², BIRÓNÉ NÉMETH E.¹, RADNAI I.¹. ¹Univ of Kaposvár, Hungary, ²Zagazig Univ, Zagazig, Egypt. pohnl@mail.atk.u-kaposvar.hu

Pannon White rabbits were inseminated artificially. The vulva colour (white, pink, red or violet) and turgidity (turgid or non-turgid) were examined at the time of insemination. Does were not treated with PMSG but they received GnRH injection. The best conception rate was found in the group of does with turgid and red or violet coloured vulva (77%). The result was lower in the groups of turgid and pink (60%) or non-

turgid and pink or violet vulva (46%). The litter size was the highest in does with red coloured vulva (turgid or non-turgid: 10.1), while lower litter size was found in group of turgid and pink or violet (9.0), and non-turgid and pink or violet coloured vulva (8.5). The number of kits born per AI was the highest if the vulva was turgid and red (7.96), while in does with turgid and violet coloured vulva it was 6.92. In the groups of turgid and pink and non-turgid and violet vulva the number of kits born per AI was 5.34 and 5.30, respectively, while it was 3.78 and 3.98 in non-turgid and pink or non-turgid and violet groups. According to the results it is suggested to assign does receptive with red or violet coloured and turgid vulva.

EFFECT OF LIGHTING SCHEDULE ON THE REPRODUCTIVE PERFORMANCE AND NURSING BEHAVIOUR OF THE DOES.

GERENCSÉR ZS.¹, THEAU-CLEMENT M.², NAGY I.¹, PRINCZ Z.¹, OROVA Z.¹, MATICS ZS.¹, BIRÓNÉ NÉMETH E.¹, RADNAI I.¹, SZENDRŐ ZS.¹. ¹Univ of Kaposvár, Hungary, ²INRA,SAGA, Castanet-Tolosan, France. pohnl@mail.atk.u-kaposvar.hu

The aim of the experiment was to investigate the effect of the increased lighting period before insemination on the reproductive performance and on the nursing behaviour of the does. The trial was carried out at University of Kaposvár with Pannon White rabbits (n=320 insemination). Before the experiment the daily lighting period was 16 hours light and the multiparous does had 5-7 parities. The animals were housed in two rooms, the only difference between the rooms was in the lighting program. In the first room a continuous 16 h lighting was performed (16-16V) while in the other room the daily lighting period was 8 hours but 8 days before insemination on d11 post partum, the lighting hours were increased to 16 h till AI (8-16V). The nursing behaviour of the does was monitored by 24-hour video recording from parturition till d14. Significant difference was found in conception rate (16-16V: 61.4 vs 8-16V: 71.9%, $P < 0.05$). The litter size was higher in group 8-16V (9.16) but the difference was not significant (8.73, $P = 0.283$). A small difference was found in body weight at

3w (16-16V: 432 vs. 8-16V: 424 g, $P=0.347$). The daily nursing events were the same in both groups but the ratio of does nursed twice a day increased from 25.6% to 41.2% between 0-3 and 12-16 days in group 16-16V. The duration of nursing was significantly longer in 16-16V (202 sec) than in 8-16V group (184 sec). The increased lighting period before insemination is a good alternative of PMSG treatment. The number of kits per AI can be increased by 23%.

INFLUENCE OF FASTING USED AS BIOSTIMULATION ON THE PERFORMANCE OF RABBIT DOES. EIBEN Cs.¹, TÓBIÁS G.¹, GÓDOR S-NÉ¹, KUSTOS K.², SZIRA G.². ¹*Res.Inst. for Animal Breed. and Nutr., Gödöllő, Hungary.* ²*Lab-Nyúl Ltd, Gödöllő, Hungary.* eiben@katki.hu

The effect of short term fasting and re-feeding before insemination (AI) on reproduction and performance of current litters was studied with 240 multiparous Pannon White does. The control group (C) was fed ad libitum and nursed freely until weaning (35 d). In group of farm practice (1X), the diet was also freely available but the females nursed once a day (from 8 to 9 h) with metal plate separation between 1-14 d and freely afterwards. In treated group (T), the biostimulation was the change of feeding, i.e. a 24 h total fasting (between 8-9 d) with 48-50 h ad libitum re-feeding prior to AI (on 11 d post partum). Here similar nursing system was used as in 1X group. In T and 1X groups, sexual receptivity was higher (0.47 and 0.45 vs. 0.27; $P=0.029$) and fertility rate tended to increase compared to C group (81.6, 84.2 and 74.4%; $P=0.686$). Kindling rate was by 8% and 14% higher in T and 1X groups than in C group (78.7, 85.5, 71.1%; $P=0.05$). The number of total born per litter seemed to be 1.0 newborn higher in T group (11.2 vs. 10.2 and 10.3; $P=0.152$). Mainly controlled nursing combined with fasting but also controlled nursing negatively affected the 35 d litter (7179, 7451 vs. 7900 g; $P=0.001$) and 35 d young weight (944, 966 vs. 1033 g; $P=0.001$) in current litters. After weaning, T rabbits gained poorer than those from 1X and C groups between 35 and 70 d (36.1 vs. 40.5 and 40.8 g/d; $P=0.001$).

Mortality rate was the same before weaning (5.0, 3.7, 4.3%) but it was higher for T and 1X rabbits during fattening (12.3, 13.5 vs. 7.9%; $P=0.01$). The kg of slaughter (70 d) rabbits per doe was lower in T than in 1X and C groups (14.54 vs. 17.53 and 17.51 kg; $P=0.009$). In T group, despite the best sexual receptivity the advantage in reproduction was moderate and it can be lost because of the poor growth and survival of young.

PRODUCTIVE PERFORMANCE OF CARMAGNOLA GREY RABBITS FROM BIRTH TO WEANING. CARLA LAZZARONI¹, F. LUZI². ¹*Fac. of Agricultural Sci., Grugliasco, Italy.* ²*Fac. of Vet. Medicine, Milano, Italy.* fabio.luzi@unimi.it

To evaluate the improvement of productive performance of Carmagnola Grey rabbits, an endangered breed indigenous to Northern Italy (Piemonte region) under selection since 1982, a research has been carried out from 2001 to 2003 on 673 litters. According to previous works, effect of parity (from 1 to 6 and more) and birth seasons (spring, summer, autumn, winter) were studied on the number of total and alive born and on the mortality rate at birth, while the effect of parity, weaning seasons and age at weaning (between 29 and 49 days of age) were studied on the number of weaned, the mortality rate at weaning and the litter and average individual weight at weaning. The results showed a good number of born alive (8.0), low mortality rate at birth (3.36 %) and at weaning (14.99 %), and a good weight at weaning, both as litter (7069 g) and as individual value (1020 g). There was a seasonal effect on the most interesting productive parameters. These results, with the performance already achieved, allowed us to continue in improving the Carmagnola Grey rabbit, a rabbit suitable for meat production and to be used as bucks in hybrid production, which performance are comparable to the commercial lines.

MILK PRODUCTION

RABBIT MILK: QUANTITY, QUALITY AND NON-NUTRITIONAL AFFECTING FACTORS.

L. MAERTENS¹, ZS. SZENDRŐ². ¹Centre for Agr. Res. Melle, Belgium, ²Univ. of Kaposvár, Hungary. luc.maertens@ilvo.vlaanderen.be

This literature review focuses on the milk yield and composition of rabbit milk and the non-nutritional factors affecting both quantity and quality. Actual high performing hybrid does have an average daily milk yield of 250 g or 60 g/kg of live weight which is in the range of productive milk cows but exceeds those of sows. However, the milk is much more concentrated in fat (12.9%), protein (12.3%) and energy (8.4 MJ/kg) which explains the extremely rapid growth of the young (weight x 6 after 3 weeks). The non-nutritional factors having the largest impact on the milk yield are the number of suckling kits, the parity (primiparous vs multiparous) and the gestation overlapping degree (rapid decline after 17 days of gestation). However, also heat stress has a detrimental impact especially when the night temperature remains above 25°C. Rabbit milk is highly saturated (70.4% SFA) due to the high content of C_{8:0} – C_{12:0} (50% of total FA) and further characterised by nearly equal quantities of oleic and linoleic acid and an ω-6/ω-3 ratio around 4. Finally some data about the amino acid and mineral composition are presented.

MILK YIELD AND MILK COMPOSITION OF 2 COMMERCIAL HYBRIDS AND A SELECTED RABBIT STRAIN FED A HIGH-ENERGY LACTATION DIET.

L. MAERTENS, J. VANACKER, J. DE CONINCK. Centre for Agr. Res., Melle, Belgium. luc.maertens@ilvo.vlaanderen.be

Milk yield (0-29 days) and milk composition were determined of 2 hybrid strains (Hycole and Hyplus) and a dam line selected for milk yield. From each strain 20 young females were tested during 2 lactations, submitted to a 52-day reproductive rhythm and fed a high energy lactation diet. Both in the 1st as 2nd lactation, differences in milk yield were small ($P > 0.05$) and total yield amounted to 5.82, 5.97 and 5.92 kg in primiparous and 7.69, 7.42 and 7.67 kg during

the second lactation for controls, Hycole and Hyplus does, respectively. Peak lactation was reached on day 20 and amounted 340, 310 and 318 g/day for controls, Hycole and Hyplus does, respectively. Hycole does were heavier ($P < 0.01$) than controls and Hyplus does. Milk yield was on average 28.8% higher in lactation 2 but 8.9% has to be attributed to the lower litter size during lactation 1 and 19.9% to the parity effect. Milk fat and protein were not significantly different between strains. Milk fat content was high due to the high-fat diet. Based on the overall data, high performing females can be characterised by a total milk yield of 8.8 kg or 71 g/kg live weight/day, with a peak lactation of 370 g and a protein and fat output on day 20 of 39 and 47 g, respectively.

MILK PRODUCTION OF PSEUDOPREGNANT DOES.

SZENDRŐ ZS.¹, MATICS ZS.¹, GYARMATI T.¹, THEAU-CLEMENT M.², NAGY Z.¹, NAGY I.¹, PRINZ Z.¹, BIRÓNÉ NÉMETH E.¹. ¹Univ. of Kaposvár, Hungary, ²INRA, SAGA, Castanet-Tolosan, France. pohnl@mail.atk.u-kaposvar.hu

The milk production of pseudopregnant does was examined in three experiments. In the first trial milk production of nulliparous does (n=16) was observed if they were injected with GnRH at 18.5 weeks of age (pseudopregnant). Applying Prostaglandin (1 mg Enzaprost / animals) treatment 16 days after GnRH injection or Oxitocyn (5NE) treatment before each nursing, the milk production increased (by 16 and 46%). Smearing the teats with Chanel-5 was not effective. In the second trial the milk production of nulliparous (n=15) and multiparous (n=20) pseudopregnant does was measured. Compared to the group of pregnant and kindled does they produced 21 and 35% less milk, respectively. In the third trial nulliparous (N) and multiparous (M) does (pregnant kindled /P/, empty /nP/ and pseudopregnant /pP/) were examined. The milk production of the NP and MpP does reached 70 and 58% of the MP does' production level (226 g milk/day). The average milk production of the MnP group was 75 g but some does produced substantially higher or lower milk than the average. Based on these results it was assumed

that in the MnP group only the does with high milk production were pseudopregnant. It was concluded that the MnP pseudopregnant does could be utilized as foster dams.

DIGESTIVE PHYSIOLOGY

EFFECT OF WEANING IN DIFFERENT AGE ON THE COMPOSITION OF THE CAECAL FLORA AND THE FERMENTATION. LUKÁCS H.¹, SZENDRŐ ZS.¹, BÓTA B.¹, BÓNAI A.¹, FÉBEL H.², PÓSA R.¹, KOVÁCS M.¹. ¹Univ of Kaposvár, Hungary, ²Res. Inst. for Animal Breeding on Nutrition, Herceghalom, Hungary. *melinda@mail.atk.u-kaposvar.hu*

The effect of weaning on day 21 (G21), 28 (G28) and 35 (G35) on body weight gain, quantity and pH of the caecal chyme, composition of the caecal microflora and volatile fatty acid composition was investigated in Pannon White rabbits. G35 rabbits had significantly higher growth rate and body weight on days 35 and 42. Weight and pH of the caecal content changed in accordance with weaning age, i.e. early weaning resulted in earlier solid feed consumption, higher content weight and faster decrease of the caecal pH as a consequence. By the 14th day Bacteroides were present in large quantities (10⁸) in the caecum, their number did not change significantly with age, however G35 rabbits had higher Bacteroides count at the age of 42 d, when compared to G21 rabbits. Early weaning (G21) resulted in higher tVFA production and a faster decrease in propionic and increase in butyric acid concentration, respectively. It could be concluded, that early weaning did not cause drastic changes in the physiological parameters examined, however resulted in lower body weight gain.

NUTRITION

INFLUENCE OF SUNFLOWER AND LINSEED OIL ADDITION IN RABBIT FEED: 1. GROWTH AND CARCASS TRAITS. EIBEN CS.¹, TÓBIÁS G.¹, GÓDOR S-NÉ¹, VÉGI B.¹, VIRÁG GY.¹, ZSÉDEY E.², TÓTH T.², SCHMIDT J.². ¹Res. Inst. for Animal Breed. and Nutr. Gödöllő. ² Univ. of West Hungary, Fac. of Agric. and Food Sci., Mosonmagyaróvár, Hungary. *eiben@katki.hu*

The aim of this work was to study the effect of 1%, 2% and 4% linseed oil (L) dietary inclusion on growth and carcass traits in Pannon white rabbits (n=250). The negative control group (C-) was fed a low energy diet (10.6 MJ/kg DE). The positive control group (C+) received a feed supplemented with 4% sunflower oil. Energy content was higher (11.4 MJ/kg DE) and equal in C+ and 1-4% L diets. During pre-feeding (21-35 d), L rabbits tended to gain better (35.3-36.8 vs. 34.8 and 34.6 g/d, $P=0.553$) and seemed to be heavier at 35 d weaning than C- and C+ rabbits (833-848 vs. 818 and 817 g, $P=0.759$). Mortality rate reduced to one half in 2% L group in the 35-84 d fattening period (14.6, 14.9, 18.4, 6.3 and 14.0% in C-, C+, 1%, 2% and 4% L groups, resp., $P=0.07$). The 35-84 d daily weight gain (36.3, 38.3, 37.2, 35.5 and 36.8 g/d, resp., $P=0.034$) was higher in C+, 1% and 4% L groups resulting in larger 84 d body weights (2608, 2703, 2664, 2565, 2628 g, $P=0.022$). The best result in C+ group was due to the slightly higher feed intake (103, 107, 104, 100, 104 g/d, $P=0.088$) and better feed conversion (2.86, 2.79, 2.78, 2.85 and 2.85, $P=0.214$). The differences in growth were neither significant among C-, 2% and 4% L groups. The inclusions did not affect the dressing out percentage (61.2-61.7%, $P=0.857$). However, the reference carcass weight was higher and did not differ in C+, 1% and 2% L groups that was lower in 4% L and C-groups (1357, 1391, 1388, 1380 and 1369 g, $P=0.004$). The oil addition increased the perirenal fat weight (22.4 vs. 28.5, 26.6, 26.0, 25.3 g, $P=0.005$) that was firm and greasy in C-, whereas softly, paler (higher L* values: 73.2 vs. 77.6, 76.6, 74.4, 76.1, $P=0.001$) and yellowish (higher b* values: 12.0 vs. 12.4, 12.7, 14.4, 14.1, $P=0.001$) in the other groups. In L groups, LD meat was darker and reddish (higher a* value), with 1-2% inclusion also yellowish. In 4% L group, also BF meat was darker but less yellowish than in the other groups. The pHu value of BF meat in 1% and 2% L groups tended to be lower compared to the other groups (6.10, 6.15, 6.03, 6.09, 6.15, $P=0.172$).

INFLUENCE OF SUNFLOWER AND LINSEED OIL ADDITION IN RABBIT FEED. 2. COMPOSITION AND FATTY ACIDS PROFILE OF THE MEAT AND LIVER.

ZSÉDELY E.¹, TÓTH T.¹, EIBEN CS.², TÓBIÁS G.², GÓDOR S-NÉ², VÉGI B.², VIRÁG GY.², SCHMIDT J.¹.
¹Univ. of West Hungary, Fac. of Agric. and Food Sci., Mosonmagyaróvár. ²Res. Inst. for Animal Breed. and Nutr. Gödöllő, Hungary. zsedelye@mtk.nyme.hu

A trial was carried out to determine the optimum level of linseed oil (L) supplementation (1%, 2% and 4%) to increase the n-3 fatty acids content of meat (intermediate part of carcass and limb meat) without decreasing growth performance, nutritional, and organoleptic characteristics with fifty Pannon White rabbits. The negative control group (C-) was fed a low energy diet (10.6 MJ/kg DE). The positive control group (C+) received a compound feed supplemented with 4% sunflower oil. Energy content was higher (11.4 MJ/kg DE) and equal in C+ and 1-4% L diets. The oil addition – except the 2% L groups for intermediate part – significantly ($P < 0.05$) increased the ether extract content of intermediate part (51.5 vs. 70.0, 64.5, 55.0 and 70.15 g/kg meat in C-, C+, 1%, 2% and 4% L groups, resp.) and limb meat (35.4 vs. 47.9, 46.8, 47.2 and 43.8 g/kg meat, resp.). Increasing L supplementation of the diet significantly ($P < 0.05$) improved the linolenic acid content in meat (intermediate part: 5.11 vs. 3.77, 13.10, 15.02 and 26.01 in % of ether extract, limb meat: 4.77 vs. 3.69, 13.25, 14.91 and 24.60 in % of ether extract) and in liver (2.31 vs. 1.41, 4.12, 4.95 and 9.12 in % of ether extract). Supplementing the diet with 4% L resulted in a more than five-fold increase in the linolenic acid concentration in limb muscle and intermediate part of carcass. The n-6/n-3 PUFA ratio was considerably lower and the PUFA/SFA ratio was significantly higher ($P < 0.05$) in the intermediate part of carcass and limb meat in L groups. Sensory traits of rabbit stew and fried rabbit meat were not affected negatively up to 2% L supplementation. On the other hand, the 4% L supplementation had a clear negative effect on the examined sensory traits.

MEAT

FAT CONTENT ESTIMATION OF RABBIT MEAT BY MEANS OF NIR SPECTROSCOPY. ROMVÁRI R., BAZÁR GY., KÖVÉR GY., LOCSMÁNDI L., SZABÓ A., ANDRÁSSY ZOLTÁNNÉ., SZENDRŐ ZS. Univ. of Kaposvár, Hungary. romvari@mail.atk.u-kaposvar.hu

Calibration. The feasibility of NIR spectroscopy on fat content (EE) determination of rabbit meat was studied. First the spectra of 90 fresh, than the freeze-dried homogenized hind leg meat samples were taken between 1100 and 2498 nm in reflectance mode. The chemical composition was determined by direct analysis. Calibration equations were developed using modified partial least-squares regression. The R^2 values in estimation of EE of the fresh and freeze-dried samples were 0.92 and 0.97, respectively. Prediction. The EE content of freeze-dried hind leg samples of rabbits from four different experimental groups (two generation CT based divergent selection for muscle content on hind legs) were estimated by NIRS method. The predicted EE content varied among 3.4–4.6% in a good accordance with the characteristic data of carcass evaluation. Significant differences were proven within the double minus and double plus selected rabbit groups in the hind leg's fat content.

PATHOLOGY

MICE PATHOGENICITY OF PASTEURELLA MULTOCIDA STRAINS ISOLATED FROM DISEASED AND HEALTHY RABBITS. VIRÁG GY.¹, KULCSÁR G.², FARSANG A.², MAKRANSZKI L.². ¹Res. Inst. for Animal Breed. and Nutr., Gödöllő, ²Inst. for Vet Medical Product, Budapest, Hungary. virag@katki.hu

P. multocida strains (n=12) have been isolated from rabbit in case of autopsy from pathognomical lesions (n=4), and from the nasal mucosa of clinically healthy (n=5) or diseased (n=3) animals. Mice were challenged intraperitoneally with 5 series of tenfold dilutions and 50% lethal dose was estimated. One strain was highly pathogenic with $LD_{50} = 1.1 \times 10^3$ CFU, and another four were also pathogenic, LD_{50} being $1.9-7.7 \times 10^5$ CFU. Three strains showing

$LD_{50} = 2.4-6.9 \times 10^6$ CFU were considered as moderately pathogenic, and four with LD_{50} above 6×10^8 as non pathogenic. A set of parameters, including health status and clinical or pathognomical lesions on sampled rabbit, colony and capsular types of the bacteria, occurrence of neurological signs or systemic infection in mice were evaluated statistically to find out if any could explain the virulence to mice. The circumstances of the isolation were found to be important, as all isolates taken from dead rabbit clustered together, and three of them were also pathogenic on mice. The remaining one was classified being non pathogenic on mice, although relatively high number of mice were killed with the concentrated inoculum containing 10^7 CFU (but none with the diluted ones). Differences in capsular serotype also showed some interaction with the circumstances. The only two capsular type F stains have been collected from healthy rabbits, and were also non pathogenic to mice, and did not produced neurological signs. All six strains taken from ill or apparently healthy rabbits were capsular type A. The lethality of these isolates to mice was heterogenous, one non pathogenic, 3 moderately pathogenic, all capsular type A, and two pathogenic were found. Considering these results it can be concluded, that ill and clinically healthy rabbits either could spread pathogenic or moderately pathogenic strains, and the proportion of the non pathogenic strains is not higher in the apparently healthy rabbits. Strains isolated from the dead rabbits are characterised by higher level mouse virulence.

HOUSING AND WELFARE

EFFECT OF THE GROUP SIZE AND STOCKING DENSITY ON THE PRODUCTIVE PERFORMANCE, CARCASS TRAITS, MEAT QUALITY AND WELFARE OF GROWING RABBITS. PRINCZ Z., ROMVÁRI R., SZABÓ A., METZGER SZ., RADNAI I., BIRÓ-NÉMETH E., OROVA Z., NAGY I., SZENDRŐ Zs. *Univ. of Kaposvár, Hungary. pohnl@mail.atk.u-kaposvar.hu*

Five-week-old Pannon White rabbits (n=230) were housed into cages (C) or pens (P). Seven groups were established depending on the

group size and stocking density (12 or 16 rabbits/m²): SC16= small cage (0,12m²), 16 animals/m²; LC16 and LC12= large cage (0,5m²) with 16 or 12 animals/m²; SP16 and SP12= small pen (0,86m²) with 16 or 12 animals/m²; LP16 and LP12= large pen (1,72m²) with 16 or 12 animals/m². Rabbits (n=90) at 11 weeks of age were slaughtered only from groups with 16 animals/m². Stocking density had no significant effect on the weight gain, body weight, feed intake and feed conversion. In the rabbit groups housed in larger pens the weight gain, body weight, dressing out percentage and fat content of meat slightly decreased but the differences were not significant. Significant differences were found for weight of perirenal fat (SC= 21.3 and LP= 13.7 g, P< 0.001) and for the ratio of the fore part to the reference carcass (LC= 28.2 and LP= 29.0 %, P<0.05). The group size affected the colour and the dry matter content of the hind leg muscle. With the increasing group size the ratio of ear lesions increased (SC= 0%, LC= 7.1%, SP= 8.7%, LP=17,4%, P<0.05).

FREE CHOICE OF GROWING RABBITS AMONG CAGES OF DIFFERENT HEIGHTS. PRINCZ Z., RADNAI I., BIRÓ-NÉMETH E., MATICS ZS., OROVA Z., SZENDRŐ Zs. *Univ. of Kaposvár, Hungary. pohnl@mail.atk.u-kaposvar.hu*

Pannon White rabbits (n=112) were weaned at the age of 5 weeks. They were housed in cage blocks using stocking densities of 16 or 12 rabbits/m². The blocks were divided into 4 cages (0.5m² each) and the animals could move freely among the cages through swing doors. In each block the height of two cages was 30 cm but it was 40 cm for the other two cages. Once a week a 24-hour video recording was taken and the rabbits were counted in each cage every half hour. In the group of rabbits using 12 animals/m² stocking density, the choice between cages of 30 and 40 cm height was similar. Examining the group of 16 rabbits/m² a small preference of 40 cm-cage height was observed. According to the results the 30 cm height fattening cages do not violate the welfare of growing rabbits.

EFFECT OF CAGES HEIGHT ON PRODUCTIVE PERFORMANCE AND INCIDENCE OF EAR LESIONS OF GROWING RABBITS. PRINCZ Z., RADNAI I., BIRÓ-NÉMETH E., GERENCSÉR ZS., NAGY I., SZENDRŐ ZS. *Univ. of Kaposvár, Hungary.* pohnl@mail.atk.u-kaposvar.hu

Pannon White rabbits (n=156) were weaned at 5 weeks of age. They were housed in cages (0,86m²; 13 rabbits/cage; 16 rabbits/m²) with wire mesh floor. The height of the cages was 20, 30 or 40 cm, or open top. The height of the cages had no effect on the weight gain, body weight, feed intake and feed conversion. The aggressive behaviour (percentage of ear lesions) was the highest in case of the 20 cm-cage height and the least in case of the 30 cm-cage height. According to the results the classical 30 cm height fattening cages had no negative effect on the production and animal welfare so they are comfortable for housing growing rabbits.

APPLICATION OF GNAWING STICKS IN RABBIT HOUSING. PRINCZ Z., RADNAI I., BIRÓ-NÉMETH E., MATICS ZS., NAGY I., SZENDRŐ ZS. *Univ of Kaposvár, Hungary.* pohnl@mail.atk.u-kaposvar.hu

Pannon white rabbits weaned at the age of five weeks were placed into wire cages (1.71×0.50 m²; 15 rabbits per cage; 17.5 rabbits per m²). After stripping the bark off, gnawing sticks were mounted horizontally 20 cm high on the wall of the adjacent wire cages. Two experiments were set. In the first experiment every cage was provided with three White locust, Black elder, White willow, Little-leaf linden, European larch, Black poplar, European white birch, White buckeye and White mulberry gnawing sticks (with a diameter of 3 cm and length of 20 cm). In the second experiment only those tree species were used that were consumed by the rabbits in the first experiment (White locust, White willow, Little-leaf linden, Black poplar and White buckeye). Gnawing stick consumption was determined from the volume differences measured at the beginning and at the end of the experiment. According to the second experiment rabbits showed the highest preference towards gnawing sticks of Little-leaf linden, while fewer

amounts of White willow and White buckeye consumption was experienced. It can be concluded the tree species of the applied as gnawing sticks should be determined according to the rabbits' preference.

EFFECT OF FLOOR TYPE AND GNAWING STICK ON THE CAGE-CHOICE OF THE GROWING RABBITS. PRINCZ Z.¹, DALLE ZOTTE A.², RADNAI I.¹, BIRÓ NÉMETH E.¹, MATICS ZS.¹, OROVA Z.¹, NAGY I.¹, SZENDRŐ ZS.¹. *Univ. of Kaposvár, Hungary.* ²*Univ. of Padova, Legnaro, Italy.* pohnl@mail.atk.u-kaposvar.hu

Five-week-old Pannon White rabbits (n=112) were weaned and housed into two blocks of cages applying stocking density of 12 or 16 rabbits/m². Both blocks were divided into four cages of wire mesh (n=2) or plastic mesh floor (n=2). In every second cage a gnawing stick was fixed on the wall. The rabbits could freely move among the four cages of the same block through swing doors. A 24-hour infrared video recording was taken once a week and the rabbits in each cage were counted every half an hour. Significantly more rabbits chose the cages of plastic floor (16 rabbits/m²: 62.5%, 12 rabbits/m²: 76.5%) than the cages of wire mesh floor. With the increasing age between 5 and 11 weeks, the ratio of rabbits on wire mesh floor increased. This results show that the rabbits accept a less preferable floor type instead of staying in higher stocking density (kg/rabbits). The preference of cages with gnawing sticks was also significant (53.1-54.1%) but this effect was less pronounced than that of the floor type.

BEHAVIOUR AND PRODUCTION OF FATTENING RABBITS IN COLONY CAGES. LUZI F., MARTINO P., VERGA M. *Fac. of Agricultural Sci., Milano, Italy.* fabio.luzi@unimi.it

The aim of this research was to test the effect of environmental enrichment (presence of a piece of wood in the cage) on performance and health of fattening rabbits. Animals were housed in colony cages (12 cages, 8 animals per cage, cage size: 50x120x40 cm; density: 0.750 cm² per animal) in semi plain-air conditions. Animals' behaviour

was video-recorded during 72 h (24 h for 3 days) at 55, 70 and 83 days of age. The video-recording covered 48 rabbits for each treatment: environmental enrichment and control group. Animals were weighed at 55, 70, 85 days; the carcass weight and yield were also analysed. Daily weight gain (49.6 ± 2.7 g vs. 46.18 ± 5.6 g) and weight at slaughtering (2973.18 ± 34.09 g vs. 2834.68 ± 34.45 g, $P < 0.01$) were higher in enriched cages, as compared to the control. The carcass yield was not different between the groups (62.2%); no injuries were detected on the carcass surface during the slaughter processing on both the environmental and control groups. In the first period the enriched rabbits were more active than the control ones; in detail, the behaviours lying and lying stretched were statistically lower. Furthermore, the enriched rabbits showed better feeding activity, maybe linked to a total higher activity. In the second (70 days of age) and third period (83 days of age) the enriched rabbits show higher feeding behaviour and cecotrophy levels. In the present research, the results show that to give rabbits a hanging wood from the cage ceiling may improve their biological functioning, increasing their growth rate without worsening their health status. As regards the behaviour of rabbit caged, the results showed that the environmental enrichment might reduce the restlessness due to stress.

EFFECT OF FEEDER LENGTH ON THE FREE CHOICE AND ON THE PRODUCTION OF RABBITS. OROVA Z., GERENCSEK ZS., PRINCZ Z., NAGY I., SZENDRŐ ZS. *Univ. of Kaposvár, Hungary.* pohnl@mail.atk.u-kaposvar.hu

The aim of the experiment was to investigate the welfare and production of growing rabbits depending on the feeder length. In the first experiment the block of cages was divided into four cages and the animals could freely move among cages through swing doors. All cages were similar, the only difference was the feeder length: 10, 20, 30, or 40 cm. The rabbits ($n=24$ /block, 16 rabbits/m²) were observed by 24 hour video recording once a week, between 5-10 weeks of age. In the second experiment weaned rabbits were housed in pens (0.925 m², 13 animals) pen, 16 rabbits/m²). The length of feeders (10, 20, 30 or 40 cm) was different. The feed intake per cage was closely correlated with the feeder length (10 cm = 12.6%, 20 cm = 18%, 30 cm = 25.4%, 40 cm = 44%) but only a weak connection was found between the choice of cages (10 cm = 22%, 20 cm = 25.3%, 30 cm = 25.7%, 40 cm = 27%). It seems that the rabbits use the feeders proportionately with their length but after finishing eating they use all cages with similar frequency for resting or moving. The feeder length had no significant effect on weight gain, body weight, feed intake and feed conversion of growing rabbits. Slightly lower production was observed in cages of 10 cm-feeder length. According to the data it seems that 1.5-2 cm space of feeder per animals is sufficient.
