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MAIN PAPERS

MAIN FACTORS AFFECTING PRODUCTIVITY IN RABBIT BREEDING. GÓMEZ E. *IVIA. Segorbe, Castellón. egomez@ivia.es*

The main factors affecting productivity in rabbit breeding are reviewed. Number of kits sold per female–cage and year are dependent on occupation rate, prolificacy, kit survival and kidding interval. Firstly, the importance of individual information and reports on technical and commercial management are underlined. Genetics and feeding practices have an influence on prolificacy, lifespan and fertility and therefore on the kidding interval. Some characteristics of extensive reproductive rhythms are pointed out. Individual productivity falls, but this could be balanced by a reduction of the renewal rate, lower kit mortality and a higher percentage of cages with nests. Finally, studies focused on the principal factors in rabbit production and estimations of commercial weightings are reviewed.

MATING MANAGEMENT TO IMPROVE PRODUCTIVE RESULTS. GARCÍA REBOLLAR P. *Dpt. de Prod. Animal. E.T.S.I. . Univ. Politécnica de Madrid.*

Nowadays, artificial insemination has improved reproductive management in big rabbit farms. The reproductive system chosen for multiparous does (intensive or semi-intensive) has a direct effect on their performance, due to the interval between partum and insemination, success is affected by the physiological state of lactation of the doe. Moreover, during this

process, rabbit does are susceptible to considerable body energy losses that affect the reproductive function. Different studies on nutritional strategies, application of less intensive reproductive rhythms or early weaning of litters have been made to reduce the energy deficit, mainly in primiparous does. However, further multidisciplinary studies are necessary (including genetics, nutrition, management, reproductive synchronization strategies etc) to reduce energy losses and provide the doe with time and means to achieve an effective and prolonged reproductive life.

FEEDING MANAGEMENT OF RABBIT DOES. CERVERA C., PASCUAL J.J. *Dpt. de Ciencia Animal. Univ. Politécnica de Valencia. Spain.*

The latest advances in feeding strategies for rabbit does are reviewed, considering the short-term productive criteria (litter size, milk production...), the long term criteria (body condition, life expectancy, health status.) and their possible effects upon the subsequent development of the litter (growth, mortality...). Genetic selection by litter size at weaning has not only selected prolificacy criteria (more live born), but also criteria of maternal aptitude (survival of the kits), which is why the does now show a greater ingestion capacity and milk production during the first weeks of life of the kits. Better knowledge of the evolution of the body condition of does, throughout the reproductive cycle and reproductive life, will provide more information on the most critical moments, the differences in the management of

reserves based on the age of the doe and the possible effect of body condition on reproductive effectiveness or longevity. The availability of this information will enable the development of global feeding programs for the reproductive doe in the future, of which some results are already available. The use of fibrous feed during the rearing period can improve the ingestion capacity of the doe, but this feeding programme must be applied early (before 70 days of age), and nulliparous does should not be mated until a suitable weight is reached. The use of high energy feeds may be effective during the initial reproductive cycles, when the ingestion capacity of the doe is the main limiting factor, but these advantages are not so important once they reach their adult doe size, where this type of feed may lead to excessive fattening or a reduction in prolificacy, and has even been related to more abrupt weaning of the kits, by encouraging milk production to a greater extent than the consumption of the kits. On this topic, greater efforts must be made in future in the study of global feeding management, taking into account the productivity of the breeding doe in the long term and the possible effect on the subsequent development of the litters.

PRE-NATAL SURVIVAL IN REPRODUCTIVE RABBIT DOES. SANTACREU JEREZ M.A. *Dpt. de Ciencia Animal. Univ. Politécnic de Valencia. msantacr@dca.upv.es*

Review of prenatal survival in rabbits. Environmental and genetic factors of prenatal survival were studied. Selection experiments for uterine capacity and results of an F2 experiment to find the genes related to prenatal survival were described. Oviductine and progesterone receptor are the candidate genes to explain differences in litter size and prenatal survival.

NEST MANAGEMENT STRATEGIES. DÍAZ J.V. *Nanta*

Intensive rabbit breeding tends to improve the efficiency of the building space, but, as a result, the nest becomes less protective. This defect must be corrected by creating a better environment and improving management. Nest

management strategies will permit us to cover all the does' necessities to find the optimal and stable production of the females in the short, medium and long term. Although there are strategies reviewed here that can be used in all farms, the protocol on maternity handling has to be adapted according to the individual characteristics of each farm.

REPRODUCTION

COMPARISON OF DIFFERENT DILUENTS ON THE QUALITY CHARACTERISTICS OF RABBIT SEMEN DURING STORAGE. ROSATO M.P.*, REBOLLAR P.G.[†], IAFFALDANO N.* **Dpt. of Animal, Vegetable and Environmental Sci., Univ. of Molise. Campobasso, Italy. nicolaia@unimol.it. † Dpt. de Producción Animal, E.T.S.I.A. Univ. Politécnic de Madrid. Madrid, Spain.*

The aim of this study was to compare the effect of MIII[®], a cheap boar semen diluent, with respect to two extenders used for the dilution of rabbit semen, Lepus[®] and Tris-citric acid (TCG) diluent respectively, on in vitro qualitative characteristics of rabbit spermatozoa stored for up 72 h at 15°C. 6 pools of semen (n 5-6 ejaculates/pool) collected via artificial vagina from 30 hybrid mature males were used. Sperm concentration was evaluated with a Thoma-Zeiss chamber and each pool was divided into 3 aliquots which were diluted with Lepus[®], M III[®] and TCG diluents, respectively, to a concentration of 30 x 10⁶ spermatozoa/ml diluent. Total sperm motility, forward progressive motility, viability (SYBR-14/Propidium Iodide procedure) and acrosome integrity (PSA-FITC procedure) were recorded at 3, 24, 48 and 72 h of storage. The storage of rabbit semen for 72 h worsened the quality characteristics of semen with the different extenders although the semen with TGC and M III diluents was less deteriorated during storage. After 3 h of storage, all the parameters were better with TGC and M III[®] compared to Lepus[®] extender, but no significant differences emerged. After 24 h the TSM ($P<0.05$) and FPM ($P<0.05$) and acrosome integrity were significantly higher ($P<0.05$) both in TGC and M III[®] diluents compared to Lepus[®] one, while no significant differences for viability

were observed between extenders. Also after 48 and 72 h better values of TSM ($P<0.01$), FPM ($P<0.01$), viability ($P<0.01$) and acrosome integrity ($P<0.05$) were found in TGC and M III[®] with respect to Lepus[®] one. Our results clearly suggest that the quality of the semen stored with TCG and MIII was comparable. Therefore, a commercial boar semen extender of reduced cost and of practical use seems to be effective for preserving rabbit semen quality during in vitro storage, although further studies are necessary to confirm its efficacy *in vivo*.

PRELIMINARY IMMUNOHISTOCHEMICAL AND HISTOLOGICAL STUDIES IN OVARIES OF SYNCHRONIZED RABBIT DOES. LORENZO P.L.*[‡], BONANNO A.[†], ARIAS-ÁLVAREZ M.[†], LÓPEZ-BÉJAR M.[‡], REBOLLAR P.G.[§] *Dpt. de Fisiología Animal. Fac. Veterinaria. Univ. Complutense de Madrid. [†]Dpt. EN.FI.MI.ZO., sez. di Prod. Animali, Fac. di Agraria, Univ. di Palermo, Italia. [‡]Dpt. de Sanidad y Anatomía Animales. Univ. Autónoma de Barcelona. [§]Dpt. de Producción Animal. ETSIA. Univ. Politécnica de Madrid. pilar.greballar@upm.es

The use of synchronization methods is necessary when artificial insemination (A.I.) is applied in lactating rabbit does in order to obtain high fertility results. The present study was undertaken to investigate the effect of PMSG treatment and the doe-litter separation method to synchronise oestrus in rabbit does in a number of ovarian morphological parameters. A total of 20 lactating multiparous does were distributed in three experimental groups: BIO (closing of nest box on day 9, controlled nursing on day 10 and 11, n=10), PMSG (20 UI administered on day 9 post-partum; n=5) and CONTROL (no treatment; n=5). Ovaries were obtained on day 11 post-partum in order to check morphometric status (weight, width and height), and to carry out histological and immunohistochemical studies to show the presence of Growth Hormone Receptor (GHR). The synchronization methods did not show any significant difference in relation to the CONTROL group. However, a slight decrease in the number of primary follicles was found in the PMSG group with respect to the Bio group, similar to the control group (25.7%, 58.9% y 42.3%, respectively; $P=0.1$).

GHR immunostaining—presence was more evident in the BIO and PMSG groups, including primordial follicles and the oocyte itself. It would thus be possible to obtain some direct effects of GH on follicular development, as described in other species. The present studies show some ovarian parameters from synchronized lactating rabbit does and open new ways of studying certain intra-ovarian mechanisms of follicular development in post-partum rabbit does.

THE RELATIONSHIP BETWEEN FERTILITY AND SEVERAL SEMEN QUALITY TRAITS. GARCÍA-TOMÁS M.*[†], SÁNCHEZ J.[†], RAFEL O.*[‡], RAMON J.*[‡], PILES M.*[‡] IRTA – Unitat de Cunicultura, Caldes de Montbui, Barcelona, Spain. [†]Dpt. de Fisiologia. Fac. de Biología. Univ. de Barcelona, Barcelona, Spain.

A total of 595 inseminations were carried out on multiparous lactating and non-lactating crossbred does with semen from 112 pools obtained from 599 ejaculates from 72 bucks. The objective was to evaluate the relationship between fertility and several semen quality traits. The semen characteristics evaluated were: pH (pH), mass and individual motility (MM, MI), percentage of viable spermatozoa (Vi), spermatozoa with normal apical ridge (NAR), normal spermatozoa (Nr), spermatozoa with morphological abnormalities of head (Ca), neck-midpiece (Cu), and tail (Co), spermatozoa with the presence of proximal (GP) and distal (GD) cytoplasmic droplet. A slight correlation was obtained between all semen quality traits and fertility and prolificacy. Two multiple models were found for fertility, including buck genetic type, MI, Nr, Cu and Vi in one model, or NAR in another model. Individual motility had an important positive effect, while NAP had a slightly negative effect.

EFFECT OF A HIGH LEVEL OF EXTRUDED FLAXSEED ON THE PRODUCTIVE AND SEMINAL PARAMETERS OF MALE RABBITS. CASTELLINI C., CARDINALI R., DAL BOSCO A. Dpt. Biologia Veg. e Biotec. Agroambientali e Zootecniche Perugia, Italy.

The aim of the study was to investigate the effect of a high level extruded flaxseed (20%) on the reproductive performance and oxidative status

of spermatozoa. Thirty New Zealand White weaned rabbits were assigned to two different diets: Control and LNA (supplemented with 20% extruded flaxseed and supranutritional level of vitamin E - 150 mg kg⁻¹). The diet affected many seminal traits. The bucks of the control group showed the lowest values of spermatozoa concentration, VCL (curvilinear velocity), ALH (amplitude of lateral head displacement) and spermatozoa responsive to Hypo-osmotic Swelling Test and Eosine Test. The LNA group showed a higher percentage of induced acrosome-reacted sperm (37.4 vs. 30.6%) with better membrane fluidity and acrosome responsiveness. In spite of the increase of PUFA in the LNA group, the semen was more stable than in the control group, probably due to the vitamin E. In conclusion, this study shows that it is possible to improve the qualitative characteristics of rabbit spermatozoa through dietary supplementation of extruded flaxseed.

WELFARE

EFFECT OF TRANSPORT AND SEASON ON PHYSIOLOGICAL STRESS RESPONSE OF COMMERCIAL RABBITS. LISTE G.*, MARÍA G.A.* , GARCÍA-BELENQUER A.†, CHACÓN G.†, ALIERTA S.‡
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In the present study we analyzed the effect of transport time, season and position on the truck, on the physiological stress response of commercial rabbits in Aragón (Spain). We tested two transport times: short (1 h) and long (7 h), two seasons: hot and cold, with three replicates per treatment. A total of 176 animals were sampled. We also analyzed the position on the truck, inside transport cages (upper, middle or lower decks). The stress indicators analyzed were corticosterone, glucose, lactate and Creatine Kinase (CK). Transport time was an important stressor for the animals; rabbits subjected to short transport times were those who showed the highest levels of corticosterone and CK. Season had a significant effect on hematocrite, corticosterone and CK values. Cold weather induced higher levels of corticosterone and hot

weather higher levels of CK. The position on the truck affected levels of glucose, corticosterone and CK, giving higher values in rabbits allocated to middle and lower positions. pH values were always within the normal range for rabbits. Season affected pH, showing an increase in animals transported during cold weather. In general, transport was an important stressor for commercial rabbits, with effects equal to season. Position on the truck seems to have an important effect on animal welfare during transport. On the other hand, pH, which is considered as one of the main parameters of welfare measurements, was not modified either by transport time or position on the truck.

EFFECT OF STOCK DENSITY AND TYPE OF FLOOR ON GROWTH PERFORMANCE, CARCASS CHARACTERISTICS AND ANIMAL WELFARE. TROCINO A., CARRARO L., FRAGKIADAKIS M., XICCATO G. Dpt. di Sci. Animali, Univ. di Padova, Agripolis, Legnaro (PD), Italia. gerolamo.xiccato@unipd.it

This study aimed to evaluate the effect of increasing stocking density (14, 16, 18 and 20 rabbits/m²) and type of floor (wire net vs. slatted floor) on productive performance, animal reactivity, carcass and meat quality of 380 rabbits weaned at 28 d of age (live weight: 640±48 g) and put in collective cages by 9 or 10. Increasing stocking density at 18 and, specially, 20 animals/m² significantly reduced daily weight gain, feed intake and final live weight. The effect of stocking density on slaughter traits mainly depended on the differences in final live weight among groups, while carcass and meat quality was not affected. During the tonic immobility test, rabbits reared at the highest density required more attempts to induce tonic immobility and remained immobile for a longer time ($P<0.01$). During the open-field test, the same animals moved less ($P=0.02$) and ran more ($P<0.01$). Keeping the rabbits on a slat floor increased daily weight gain ($P=0.07$), final live weight ($P=0.07$) and feed intake ($P<0.01$) in comparison with a wire net floor, while it did not modify slaughter traits and carcass and meat quality. The attempts to induce immobility were

fewer ($P < 0.01$) and biting during the open-field test was higher in rabbits kept on a slat floor. In conclusion, increasing stocking density above 18 rabbits/m² impaired productive performance, especially in the last two weeks of growing as a consequence of a reduced feed intake, and modified animal reactivity towards man or a new environment. The type of floor showed a weak effect on productive performance and reactivity, whereas a slatted floor was likely more comfortable for the heavier animals in the last weeks of the fattening period.

NUTRITION

RESPONSE OF A LINE HYPER SELECTED FOR REPRODUCTIVE LONGEVITY TO DIFFERENT PRODUCTIVE CHALLENGES. THEILGAARD P., RÓDENAS L., MARTÍNEZ E., SÁNCHEZ J.P., BASELGA M., PASCUAL J.J. *Dpt. de Ciencia Animal. Univ. Politécnica de Valencia. Valencia.*

A total of 130 rabbit does, 59 from a genetic line (V) intra-line selected for litter size at weaning and 71 from a line (LP) hyper selected for reproductive longevity (minimum of 25 cycles) and average reproductive performance (7.5 born alive), were used to evaluate response of the animals to different productive challenges during their 2nd lactation. In each line, 3 experimental groups were constituted: PP9 (previous mating post-partum and 9 kits), PD9 (previous mating post-weaning and 9 kits) and PD5, (previous mating post-weaning and 5 kits). Feed intake was higher for LP does (322±4 g/d) than for V does (304±5 g /d). Milk yield of LP does was also higher (214±3 g/d) than for those from V line (194±3 g/d), especially for large litter size groups (+12 and +13% for PP9 and PD9 groups, respectively). Females of the LP line showed a greater live weight (4128±41 g) than V does (4001±45 g). These differences were not obvious in the PP9 group (+46±106 g), increased for the PD9 group (+138±103 g) and were only significant for the PD5 group (+207±103 g; $P < 0.05$). Rabbit does from the LP line showed a significant greater perirenal fat thickness than those from V line at the post-partum day (+0.50 mm; $P < 0.01$), but no significant difference was detected after this time. These results confirm

the integrated role of body reserves on survival and reproduction properties of rabbit does.

PREDICTION OF BODY COMPOSITION BY BIOELECTRICAL IMPEDANCE (BIA) IN RABBIT DOES: PRELIMINARY RESULTS. CORCHADO V.*, REBOLLAR P.G.*, PEREDA N.*, ROSATO M.P.†, IAFFALDANO N.†, GARCÍA REBOLLAR P.*, NICODEMUS N.* **Dpt. de Producción Animal, ETSIA, Univ. Politécnica de Madrid. nuria.nicodemus@upm.es †Dpt. of Animal, Vegetable and Environmental Sci., Univ. of Molise, Campobasso, Italy.*

The purpose of this experiment was to evaluate the accuracy of a bioelectrical impedance technique (BIA) to estimate in vivo body composition of reproductive rabbit does. Thirty-six female rabbits (New Zealand x Californian, weight range: 3173-5736 g) at different physiological states were used. A body composition analyser (Model BIA-101, RJL Systems, Detroit, MI USA) was used to determine resistance and reactance values. After BIA assessment, animals were slaughtered and stored at -20°C until chemical analyses (dry matter, lipids, proteins, ash and energy). A multiple regression analysis was employed to develop prediction equations for chemical composition. The physiological state, included as a fixed effect in the statistical model, was not influenced by fat and energy content. The live weight, parity order, resistance and reactance explained 69% and 77% of the total variability observed on the fat and energy (MJ) content of the doe rabbits, respectively. The inclusion of the physiological state explained 85% of the total variability observed on the water content. In the ash estimation ($R^2 = 62\%$) the physiological state, live weight, parity order and resistance were used as independent variables. BIA measurements were not included in the estimation of the total protein content. The physiological state and the live weight of the doe rabbit accounted for 71 % of the total variability observed in the protein content. These results are preliminary and further studies with bioelectrical impedance procedures are needed to validate their potential application.

USE OF A FEED RICH IN DIGESTIBLE AND INDIGESTIBLE FIBRE AND POOR IN STARCH FOR GROWING RABBITS: TRIAL IN FIELD CONDITIONS. FABRE C.*, JUVERO M.A.*, BLAS E.†, FERNÁNDEZ-CARMONA J.†, PASCUAL J.J.† *GUICO. Grupo Arcoiris. Valderrobres. Teruel. †Dpt. de Ciencia Animal, Univ. Politécnica de Valencia.

Between February and April of 2005, 5 trials were carried out in five farms of the region of Matarraña (Teruel). After weaning, the rabbits were fed *ad libitum* on feed C (the normal diet in these farms; control group) or P (richer in both digestible and indigestible fibre, and poorer in starch, essentially as a result of the substitution of barley and wheat bran by beet pulp; experimental group); the week before slaughtering all the animals received the same non-medicated commercial feed. The antibiotic treatments in feed or drinking water varied in the different trials: in Trials 1 and 2, the control groups were treated but not the experimental groups, whereas in Trials 3, 4 y 5 both groups were subjected to identical treatments during growing. In these last cases, a reduction of mortality in the experimental group in comparison with the control group was observed (2.4 vs. 4.3%, NS, in Trial 3; 5.3 vs. 13.4%, $P < 0.01$, in Trial 4; 8.3 vs. 16.2%, $P < 0.001$, in Trial 5). The use of feed P did not seem to affect the live-weight at slaughtering but did cause a reduction of the carcass yield (56.16 vs. 56.88% for the experimental and control groups respectively, $P < 0.01$).

ILEAL DIGESTIBILITY IN WEANING RABBITS OF FEEDS DIFFERING IN DIGESTIBLE FIBRE, STARCH AND ANIMAL FAT. SOLER M.D.*, BLAS E.†, BIGLIA S.†, CASADO C.†, MOYA J.†, CERVERA C. † *Dpt. de Prod. Animal y Ciencia y Tecn.de los Alimentos, Univ. Cardenal Herrera-CEU, Moncada Valencia. †Dpt. de Ciencia Animal, Univ. Politécnica de Valencia, Valencia.

352 young rabbits were used to determine the apparent ileal digestibility of 4 experimental feeds between 29 and 43 days of age. The first three feeds (A, B, C) contained increased digestible fibre and decreased starch levels (basically, by incorporation of beet pulp in substitution of wheat); all of them contained 3% of animal fat.

The fourth feed (D) was similar to feed C but included more animal fat (6%). The ileal digestibility of DM varied significantly between the different feeds, being lower for higher digestible fibre content and poorer in starch (from 33.9% for feed A until 22.4% for feed C), with no effect associated with higher animal fat inclusion. Ileal digestibility of starch was also affected significantly by both the feed and the interaction between feed and age, so that it increased as the feed was richer in digestible fibre and poorer in starch, being specially low for feed A at 29 and 36 d (92.6% and 89.5%, respectively). This allowed an ileal flow of starch at these ages to be considered 9-11 fold higher for this feed than for feed C. A significant increase was observed for ileal digestibility of DM, CP, ADF and starch (in this last case, mainly by the results in feed A) between days 36 and 43, which could be explained as a consequence of digestive maturation. Nevertheless, the fact that the ileal digestibility of DM and CP is significantly greater at 29 d than at 36 d is on the surface more surprising.

EFFECT OF LEVEL AND TYPE OF FIBRE ON GROWTH PERFORMANCE AND THE ILEAL DIGESTIBILITY IN GROWING RABBITS. ALVAREZ J.L.*, MARGÜENDA I.†, GARCÍA-REBOLLAR P.*, CARABAÑO R.*, DE BLAS J.C.*, GARCÍA-RUIZ A.I.† *Dpt. de Producción Animal, UPM, Madrid; †Nutreco PRRC, Toledo.

The aim of this trial was to study the effect of level (30 vs. 36% NDF) and type of fibre (wheat straw vs. apple pulp) by measuring animal performances and digestive parameters from 21 to 35 and from 35 to 63 days of age. Two lactation (L1 and L2) and three fattening (C1, C2 and C3) feeds were formulated. Lactation feeds contained 30% NDF from different fibre sources (wheat straw (L1) vs. apple pulp (L2)). The C1 diet was identical to L1 whereas C2 and C3 had a higher level of neutral detergent fibre (36% NDF) with wheat straw and apple pulp as main fibre sources, respectively. From 21 to 35 days a total of 110 does (55 per treatment) and their litters were controlled in the course of two consecutive lactations. At 35 days of age 480 animals housed

in collective cages (four rabbits per cage) and 180 rabbits housed in individual cages were weaned and assigned to each experimental fattening diet (C1, C2 and C3). To determine the apparent ileal digestibility of dry matter (DM) and crude protein (CP), at 36 days of age 60 rabbits were slaughtered by cervical dislocation after a period of 10 days of feed adaptation. From 21 to 35 days of age animals fed diet L1 (based on wheat straw) showed 5.9 and 6.9% higher daily feed intake and body weight at 35 days of age than animals fed diet L2 (based on apple pulp). From 35 to 63 days of age animals housed in individual cages reached a 3.1, 6.3 and 11.4% higher final body weight, daily weight gain and daily feed intake, respectively than animals collectively lodged. On the other hand, the feed conversion rate was 4.9% lower in collectively than individually located animals. Rabbits fed diet L1 in the previous period (from 21 to 35 days) reached higher performances in the fattening period than animals fed diet L2. However, animals fed diet L2 showed 2% lower FCR than animals fed diet L1. In the fattening period, animals fed diet C1 (30%NDF; wheat straw) showed 3.6 and 5.9% higher weight at 63d and weight gain, respectively, and 3.3 and 8.8% lower feed intake and feed conversion rate, respectively, than animals fed diet C2 (36% NDF; wheat straw). Animals fed diet C2 (36% NDF; wheat straw) reached 4.6, 7.6, 14.3 and 6.5% higher body weight at 63 d, weight gain, feed intake and feed conversion rate, respectively, than animals fed diet C3 (36% NDF; apple pulp). Rabbit mortality was also low and no significant effect of diet was detected in the fattening period. As had been expected, a significant effect of fibre level and type was detected in the apparent ileal digestibility of DM (ID_{DM}). The highest ID_{DM} values were obtained for diets C1 and C3 (9.5% higher values than the ID_{DM} of C2). From the results obtained it can be concluded that the addition of 10 and 14% of apple pulp from 21 to 35 and from 35 to 63 days of age leads to an impairment of the performance parameters. In low mortality and enteropathy incidence conditions, diets with 30% NDF and wheat straw as main fibre source would lead to better performance in

the fattening period than feeds containing higher fibre levels (36% NDF).

EFFECT OF DIETARY ENERGY LEVEL ON GROWTH PERFORMANCE, MORTALITY AND CARCASS WEIGHT IN RABBITS. CARRILHO M.C.*, LÓPEZ M.*, MATEO A.†**Fac. de Veterinaria. Dpt. Producción Animal y Ciencia de los Alimentos. Zaragoza. marina@unizar.es. †Veterinario. garlic@colvet.es*

The effect of three diets with different energy levels (A: 2300 kcal; B: 2205 kcal and C: 1900 kcal) on the evolution of the weight, growth and carcass yield in a total of 429 rabbits distributed into three groups in two replicates (about 50% in each one) was analyzed. The diets were given from the beginning to the third week of fattening, when they were replaced by the finalizing diet (2360 kcal). The animals which were fed the diet A presented higher weights when the diet was replaced, as well as by the end of the fattening period, although significant differences ($P < 0.05$) were only observed at the end of the three weeks of the fattening period. At that stage, those of the C diet had the lowest weights (1448.31 ± 186.20 y 1500.58 ± 245.72) and those of the B diet presented an intermediate weight (1488.19 ± 200.48 y 1534.70 ± 272.87). No significant differences in the weights of the three animal groups were found at the end of the fattening period. During the first phase of the fattening period the groups A and B had a significantly higher growth rate than the C group ($A = 38.44 \pm 6.31$ y 38.33 ± 8.16 y $B = 36.75 \pm 6.06$ y 33.67 ± 14.33) which, when it started to receive the finalizing diet, showed a phase with high growth. During the first control, the mortality was 1.35%, 1.35% and 5.41% in groups A, B and C, respectively. The tendency reversed during the second control, when mortality reached 10% in group A, 4.45% in B and only 1.47% in group C. The mortality affected the young rabbits in contiguous cages in both replicates. In relation to the slaughtered rabbits, no significant differences were observed among groups either regarding live slaughter weight, or cold carcass weight and commercial carcass yield in animals of 2 kg ($n = 90$). Also, the carcass yield was no

different in those rabbits slaughtered at 2.250 Kg, which increased to above 58% in all groups.

EFFECT OF WEANING AGE (25 VS. 35), THE FARM AND THE PERIOD ON MORTALITY AND PERFORMANCE OF GROWING RABBITS.

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The aim of this work was to study the effect of the weaning age (25 vs. 35 d), the type of farm (cleaned and disinfected or otherwise) and the period (corresponding to two consecutive parturitions) on the mortality and performance of young rabbits from weaning until 56 d of age. A total of 668 New Zealand x Californian young rabbits were allotted at random among the eight treatments. The mortality was affected by the period, the farm and the weaning age, being higher in the second period (20.2 vs. 14.5 %, $P=0.05$), in the farm without cleaning and disinfection between cycles (20.0 vs. 14.2%, $P=0.03$) and in the animals weaned at 35 d of age (20.0 vs. 14.7%, $P=0.06$). An interaction was observed between the weaning age and the farm ($P<0.001$) on mortality. Mortality in animals weaned at 35 d was lower in the cleaned and disinfected farm with respect to the non-disinfected farm, while in those weaned at 25 d was similar in both farms. An interaction between the farm and the period was also found ($P=0.02$). Mortality in the second period was 49% higher in the non-cleaned and disinfected farm, while in the first cycle it was similar in the two farms. Animals weaned both at 25 and 35 d had a peak of mortality around two weeks post weaning. The average weight of the young rabbits at 56 d was similar between the animals weaned at 25 and 35 d of age (1805 vs. 1787 g, respectively; $P=0.54$). However, the feed efficiency in the whole fattening period was higher in the young rabbits weaned at 25 d than in those weaned at 35 d (0.392 vs. 0.298 g/g; $P<0.01$).

EFFECT OF FEED RESTRICTION, DAILY FEED DISTRIBUTION, AND NUMBER OF FEEDERS ON GROWTH RATE AND ITS VARIABILITY. TUDELA F.*, LEBAS F.† *SELAP, INRA Centro de Investigación de Toulouse, Francia. †Cunicultura, Corrosac, Francia.

A total of 1768 fattening rabbits were used in 3 successive experiments to study the effects of feed restrictions (100% - 80-85% or 60%): 1 or 2 feeds daily, 1 - 2 or 4 feeding places in each cage with 6 or 8 fattening rabbits. As expected, feed restriction reduced the daily weight gain by 8 to 17% with 80% restriction, but improved feed efficiency. At 80-85%, feed restriction has no effect on intra-cage final weight homogeneity. A higher restriction (60%) increases intra-cage weight standard deviation used to measure homogeneity by 22%. Increasing the number of feeding places or the double daily feed distribution does not improve any of the controlled criteria (weight, homogeneity, feed efficiency), even if the intra-cage heterogeneity was experimentally increased (light, medium and heavy rabbits housed in the same cage). The conclusion of the authors was that in case of feed restriction, the total daily allowance should be distributed at the same time and that the number of feeding places has no importance.

EFFECT OF DIETARY SUPPLEMENTATION OF ESSENTIAL OILS OR PLANT EXTRACT MIX ON MORTALITY AND GROWTH PERFORMANCE IN GROWING RABBITS. COLIN M.*, PRIGENT A.Y.†

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The effects of incorporating 4 essential oils or plant extracts in the feed on mortality and growth of rabbits were studied on 3600 rabbits. No medicated feed was used and the weaned rabbits came from a maternity using no medication. They were fed *ad libitum*. All 4 mixes reduced mortality compared to the control feed. At the beginning of the growing period, the lowest mortalities are obtained with an essential oil mix with a large spectrum of efficiency against micro-organisms involved in digestive pathology (COPRIFIT) and used at 1.5 Kg/ton. At the end of the growing-fattening period, mortality is stabilized by a mix of 1 Kg/ton of COPRIFIT and of 2 Kg/ton of

vegetable extracts efficient at respiratory and immune levels, COPRIPUR. COPRIFIT used alone at 1 Kg/ton or COPRIDIGEST, an essential oils mix efficient against *Clostridium* and *Eimeria*, have an intermediate efficiency. Some essential oils and plant extract mixes, particularly the most effective in terms of reducing mortality, cause a slight growth reduction. In conclusion, essential oils and plant extracts can be useful to keep rabbits healthy, but have to be used according to the animal physiological conditions and the dominant pathology of the farm.

TRUE AND APPARENT AMINO ACID DIGESTIBILITY OF SUNFLOWER MEALS, SOYBEAN PRODUCTS AND PEAS IN RABBITS.

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The aim of this work is to determine the protein and amino acids ileal digestibility, corrected for endogenous losses, of sunflower seed meals, soybean meal, full-fat soybean and peas for rabbits. Thirty New Zealand White x Californian doe rabbits fitted with a T-cannula at the terminal ileum were used. Five diets were formulated with 35% of sunflower meals and peas and 30% of soybean products, and a casein-basal diet for determination of endogenous losses. The endogenous protein losses at ileal level were 3.2 g/d and at faecal level, 2.2 g/d. The ileal endogenous protein showed a high content in glutamic acid (12.5%) and essential amino acids such as threonine, valine and leucine (5.5%, 5.1% and 4.3%, respectively). The apparent ileal digestibility (AID) was 9.9 points lower on average than the true ileal digestibility (TID). The apparent faecal digestibility (AFD) of sunflower meals and peas was 4.1 points lower than TID, due to their lower endogenous losses with respect to the ileal level. Lysine TID was higher than methionine TID for all protein concentrates (97.0% vs. 93.6%, respectively), except for sunflower seed meal 38 (93.6 vs. 94.2%). Threonine TID was the lowest, although it was the most important as regards limiting amino acids in the endogenous ileal flow. On

the other hand, methionine AFD was higher than lysine AFD. In conclusion, correcting endogenous losses produces changes in the relative digestibility values of feeds.

EFFECT OF THE DIETARY TOYOCERIN® SUPPLEMENTATION ON THE PERFORMANCE OF PRIMIPAROUS RABBIT DOES IN THE FIRST REPRODUCTIVE CYCLE. PINHEIRO V.*, MOURÃO J.L.*, SILVA C.†, JIMÉNEZ G.‡ *CECAV, Univ. de Trás-os-Montes e Alto Douro, Vila Real, Portugal. †Univ. de Trás-os-Montes e Alto Douro, Vila Real, Portugal. ‡Rubinum, Barcelona, España.

This study was intended to evaluate the effects of Toyocerin® (Toyocerin 10⁹- premix) on the performance of primiparous rabbit does in the first reproductive cycle. The experiment was conducted in the facilities of UTAD between October 2005 and January 2006. A total of 102 UPV does were assigned at random to each of the three experimental groups: T0 group (basal diet - negative control); T200 group (basal diet + 200mg Toyocerin® /kg of feed) and T1000 group (basal diet + 1000mg Toyocerin® /kg feed). Diet was given *ad libitum* in granulated form. The feed contained only Robenidin as a coccidiostatic. During the trial the does, pups and feed were weighed at the beginning of the experiment, at the time of artificial insemination, at parturition, at the time milk production was controlled (18 d after the parturition - lactation control) and at weaning. The results suggest that the use of Toyocerin® had a positive effect on feed intake of lactating does. Between parturition and weaning, an increase of 50 g/d ($P<0.05$) was observed in the T200 and T1000 group (T0 with 469 g/d). The same trend was observed (more than 76 g) between lactation control and weaning (T0 with 567 g/d). At birth, the pups of T200 females were heavier ($P<0.05$) than the pups of T0 females (50,6 g vs. 44,7 g). There was also a higher ($P<0.05$) weight gain between lactation control and weaning for the pups of Toyocerin® groups (36 g/d) when compared with the T0 group (33,2 g/d). The rabbits' weight at weaning showed a tendency ($P=0.07$) to increase when animals were fed with Toyocerin® (an increase of 45 to 50 g).

AN EVALUATION OF THE IMPACT OF MEDICATED DIETS ON CAECAL FERMENTATION OF GROWING RABBITS. ABECIA L., FONDEVILA M., BALCELLS J., BERENGUER A. *Dpt. de Prod. Animal y Ciencia de los Alimentos, Fac. de Veterinaria, Univ. de Zaragoza.*

The possible side-effects of dietary inclusion of antibiotics, in a diet containing anti-pathogen medication, on microbial fermentative activity in the rabbit cecum were studied. Twenty-four growing New Zealand rabbits weaned at 28 d (667 ± 25.5 g initial weight) were allocated to 4 treatments of 6 rabbits. Diets consisted of a common mixed feed (NAB) as a control, supplemented with 100 ppm bacitracin (BAC), 400 ppm chlortetracycline (CTC) or 100 ppm tiamulin (TIA), antibiotics and doses commonly used in rabbit therapy. Rabbits were given the experimental diets *ad libitum* for 28 d, being weighed individually every week. Animals were slaughtered at the end of the experimental period and their cecum excised. No significant differences were found on growth rate, although with CTC it tended ($P=0.10$) to be lower, whereas cecal weight was the highest with CTC ($P<0.01$). The CTC treatment showed a numerically lower VFA concentration ($P<0.10$). The proportion of propionate was higher ($P<0.01$) and that of butyrate was lower ($P=0.03$) with CTC than TIA, with NAB and BAC recording intermediate proportions. Treatments did not affect either total anaerobic bacterial counts or polysaccharidase activity of the microbial population, although xylanase activity with NAB was more than two-fold that of BAC. These antibiotics did not have a major effect on the overall cecal microbial environment, and only an increase in the propionate proportion with CTC and a higher butyrate proportion with CTC than TIA were noticeable, suggesting a qualitative effect on the caecal bacterial biodiversity.

PRODUCTION

EFFECT OF LEVEL AND TYPE OF FIBRE ON GROWTH PERFORMANCE AND ILEAL DIGESTIBILITY IN GROWING RABBITS. BAENA, P.L., GARCÍA, M.L., MUELAS, R., AGEA, I., RODRÍGUEZ, B., ARGENTE, M.J. *Univ. Miguel Hernández de Elche. Alicante. mj.argente@umh.es*

A total of 478 litters from 168 F2 does were used to analyze the effect of lactation and season on litter size, survival of kits and weight of litter size during lactation. Nulliparous females had almost a kit less than the multiparous females throughout lactation. The non lactating primiparous females showed a smaller litter size at birth (-1.46 kits, 16%) and at weaning (-0.80 kits, 11%) than non lactating multiparous females. A negative effect was found in summer for survival of kits in the first week. Litters of nulliparous and non lactating primiparous females weighed less at birth (427 g and 429 g) than lactating primiparous and lactating and non lactating multiparous females (500, 515 and 496 g, respectively). At weaning, litters of nulliparous, non lactating primiparous and multiparous females weighed less (3999, 3775 and 3995 g, respectively) than those of lactating primiparous and multiparous females (4339 and 4598 g, respectively). Weight of the litters in lactating primiparous females was higher than in non lactating primiparous females, at birth (+70 g, 14%) and at weaning (+563 g, 13%). Summer and autumn had a positive effect on weight of litter throughout lactation.

FACTORS RELATED TO GROWTH OF KITS DURING LACTATION. ARGENTE, M.J., BAENA, P.L., AGEA, I., MUELAS, R., RODRÍGUEZ, B., GARCÍA, M.L. *Dpt. de Tecn. Agroalimentaria. Univ. Miguel Hernández. Elche, Alicante. mj.argente@umh.es*

A total of 3661 kits were used to analyze the effect of physiological stage of female, season and milk intake of the kits throughout the 24 hours after birth on birth weight and growth of kits during lactation. Weight of kits was lower (from 14 to 8%) in nulliparous females than in lactating or non lactating primiparous and multiparous females throughout lactation. Summer had a negative effect on growth of kits

during lactation; weight and average daily gain of kits in this season were lower than in other seasons (around 14% less at birth and 28% at weaning). A positive effect of suckling was found for weight and average daily gain (15% more at birth and 4% more at weaning). Average daily gain was reduced 22% in the third week vs. second week of lactation. This decrease could be due to the change in the type of feed ingested by the kits (milk plus solid feed).

RELATIONSHIP BETWEEN THE BIRTH WEIGHT AND THE SURVIVAL AT THE FIRST WEEK OF AGE IN RABBITS. GARCÍA, M.L., BAENA, P.L., MUELAS, R., AGEA, I., ARGENTE, M.J. *Dpt. de Tecn. Agroalimentaria. Univ. Miguel Hernández, Elche. Alicante*

The weight at birth of 3661 rabbits, the litter size of 478 deliveries and the survival at the first week of age were controlled. The relation between litter size at birth and individual weight at birth is a quadratic ($b_1 = -4.55 \pm 0.62$; $b_2 = 0.14 \pm 0.04$). When weight at birth decreases litter size increases. This tendency is maintained until the reduction of the weight is compatible with the viability of the rabbits. There is a linear relationship between the standard deviation of the individual weight at birth and the litter size at birth (0.18 ± 0.05). The linear regression coefficients of survival on the average weight at birth (0.001 ± 0.0003) and on the standard deviation of this weight (-0.003 ± 0.001) are significant, but these results are not relevant.

MOTIVATIONS FOR THE ABSENCE OF RABBIT MEAT CONSUMPTION IN A POPULATION OF UNIVERSITY STUDENTS. GONZÁLEZ REDONDO P. *Dpt. de Ciencias Agroforestales. Universidad de Sevilla. España. pedro@us.es*

In a survey of students (n=342) of the University of Seville, 86% of the young people had previously eaten rabbit meat, 62% consuming it currently. Between those who did not consume it currently, 48.5% avoided it for its organoleptic characteristics, 37.7% did not consume it by reason of not being accustomed to its consumption and 13.8% avoided eating it for emotional and moral reasons. Between the 84

subjects that had previously eaten rabbit meat and that did not consume it currently, the majority of them did not consume it for its organoleptic characteristics (54.8%) or by reason of not being accustomed to its consumption (40.5%). Between those who did not currently consume rabbit meat (n=130), women avoided its consumption mainly for emotional and moral reasons, and men by reason of not being accustomed to its consumption. In this group, those who had a hunter in their family mainly avoided this meat for its organoleptic characteristics and those who did not have hunters in their family did not consume it mainly by reason of not being accustomed to its consumption. Those who had had rabbits as pets avoided consumption for emotional and moral reasons and those who had not had pets of this species did not consume rabbit meat by reason of not being accustomed to its consumption. The reasons for not consuming rabbit meat were similar to those indicated by young adults for not consuming other types of meat.

PATHOLOGY

RELATIONSHIP BETWEEN GENETIC DIVERSITY AND VIRULENCE OF DIFFERENT STOCKS OF STAPHYLOCOCCUS AUREUS IN RABBITS. VIANA, D.*, SELVA, L.*, SEGURA, P.*, PERIS, B.*, PENADÉS, J.R.† Y CORPA. J.M.* **Dpt. de At. Sanitaria, Salud Pública y Sanidad Animal, Univ. Cardenal Herrera-CEU, †Centro de Inv. y Tecn. Animal. IVIA, Segorbe. Castellón. jmcorpa@uch.ceu.es*

Staphylococcus aureus is a common pathogen that colonizes and produces disease in a variety of hosts. In rabbits this bacteria causes suppurative inflammatory reaction in practically all organs and locations and, frequently, fatal septicaemia. Three hundred and twenty-nine *S. aureus* isolates from different purulent lesions were studied. The animals came from 39 industrial rabbitries located in several districts of the Valencia Autonomous Region on the Spanish Mediterranean coast. Molecular typing was performed using the polymorphism in the length of fragments after the PCR product restriction of coagulase, a protein and clumping factor B gene, as selected criteria. Sixteen different *S.*

aureus strains were obtained. Thirty-eight isolates representative of each molecular and origin lesion type were selected and different genes from *S. aureus* involved in pathogenesis were analyzed by PCR. It was observed that stocks of the same molecular type showed similar virulence factors, regardless of the origin of the lesion, implying great variability. This lack of a relation between the lesions produced by different stocks and their genetic arsenal could indicate either that the virulence factors are not directly involved in the lesion or, which is more probable, that the immunity of the host plays an important role in disease pathogenesis.

ROLE OF NASAL CARRIAGE IN PATHOLOGIES ASSOCIATED WITH *STAPHYLOCOCCUS AUREUS* IN RABBITS. SELVA L.* , VIANA D.* , PENADÉS J.R.† Y CORPA. J.M.* *Dpt. de At. Sanitaria, Salud Pública y Sanidad Animal, Univ. Cardenal Herrera-CEU, Valencia; †Centro de Inv. y Tecn. IVIA, Segorbe. Castellón. jmcorpa@uch.ceu.es

Introduction: *Staphylococcus aureus* often colonize the anterior nares, and nasal carriages constitute the main source of bacterial dissemination. Objective: To demonstrate the importance of the state of the carrier in the later development of injuries. Methods: Taking samples from the nasal mucosa of reproductive female rabbits (healthy and diseased) from several industrial farms and identification of *S. aureus*. Results: 92.45% of the females with *S. aureus* lesions turned out to be nasal carriers, whereas only 58.53% of the healthy animals were such. Conclusion: A relationship between animals with injuries and the presence of the *S. aureus* in the nose is detected.

ARE THE PHAGES A THERAPEUTIC ALTERNATIVE TO THE USE OF THE PRESENT ANTIMICROBIALS AGAINST *STAPHYLOCOCCUS AUREUS*? SELVA L.* , VIANA D.* , PENADÉS J.R.† , CORPA J.M.* *Dpt. de At. Sanitaria, Salud Pública y Sanidad Animal, Univ. Cardenal Herrera-CEU, Valencia; †Centro de Inv. y Tecn. Animal. IVIA, Segorbe. Castellón. jmcorpa@uch.ceu.es

Staphylococcus aureus is a major pathogen responsible for staphylococcal infections in rabbits. *S. aureus* is isolated in most industrial farms and treated by medication, sometimes excessive, that gives rise to frequent cases of antibiotic resistance in the animals. The appearance of resistance to antibiotics has again made specialists consider phages as a therapeutic alternative to the use of the present antimicrobials.

ECTOPIC PREGNANCY, DO YOU SEE IT? VIANA D., SELVA L., SEGURA P., ORTEGA J., CORPA J.M. Dpt. de At. Sanitaria, Salud Pública y Sanidad Animal, Univ. Cardenal Herrera-CEU, jmcorpa@uch.ceu.es

Abdominal pregnancy is defined as the implantation and development of a fertilized ovum or an embryo in the peritoneal cavity. Although this has been reported in several species, it is considered as a low incidence process. It is classified as a primary abdominal pregnancy if there is no evidence of uterine rupture, with presumed regurgitation of early embryos from the uterine tube and as a secondary abdominal pregnancy when there is evidence of uterine rupture. During a necropsy study of 648 adult fertile female New Zealand white rabbits (*Oryctolagus cuniculus*) from six rabbit farms in Valencia (Spain), the main causes of elimination were studied. Thirty-five abdominal pregnancies were diagnosed. 33.33% of these animals showed no lesions in their reproductive tract. The remaining 66.66% showed acute or chronic lesions in the reproductive tract. The classification as a primary or secondary condition is discussed. It can therefore be concluded that extrauterine pregnancies are not unusual in rabbits, and that this premise should be considered in the diagnostic approach when assessing rabbit doe pathology. New husbandry systems in rabbits, such as artificial insemination, are factors to be considered.