

## ABSTRACTS OF THE 48<sup>TH</sup> SYMPOSIUM ON CUNICULTURE, ASESCU

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The 48th Congress of the Spanish Association of Cuniculture (ASESCU) was held in Córdoba, Andalusia, Spain. The congress was organised by ASESCU in collaboration with the Faculty of Veterinary Medicine and the University of Córdoba. A total of four main lectures were delivered. One of these lectures discussed the current state of cuniculture in Andalusia, while another examined the evolution of the sector in Italy. Another lecture focused on state-of-the-art of alternatives to cages for rabbit housing, and the fourth lecture covered new rabbit lines developed for disease resistance. Additionally, two round tables were held, discussing the main challenges in the rabbit farming sector and new veterinary legislation. A total of 25 communications were presented on various topics, including nutrition, genetics, reproduction, housing and welfare, pathology and products. The event was attended by approximately 130 participants from various European and American countries. Below are the abstracts of the contributions.

### MAIN PAPERS

#### RABBIT FARMING IN ANDALUCIA

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The livestock sector in Andalusia is of great importance, accounting for 15% of Final Agricultural Production. It is the tenth Spanish autonomous community in terms of census and rabbit farms. A total of thirty-four farms are registered, of which six are for meat production, three for breeding animals for release or restocking, eight for breeding animals for experimentation, fifteen school farms, three commercial operators and one didactic-experimental farm. Granada and Málaga are the provinces with the highest percentage of farms. There is a high number of registered self-consumption farms. The total number of animals is around 23.000. There is a slaughterhouse in Ugijar (Granada), to which local animals are sent. The main destination of fattening animals is to slaughterhouses in Murcia and Albacete. There has been a major reconversion of the sector with a significant reduction in the number of slaughterhouses and farms, concentrating the census

in larger farms, where most of them have more than 800 places for breeding rabbits. Meat consumption is low, due, among other factors, to low demand from younger consumers. The wild rabbit is of great ecological importance, with a medium-low density, mainly due to viral diseases. This species as a companion animal is becoming increasingly important every day, having to comply, in application of the regional sectorial regulations, with the same identification, health and animal welfare requirements as those of farm animals, so they need to have a vaccination plan against myxomatosis and viral haemorrhagic disease for its two variants. The regional regulation establishes as compulsory 20-h animal welfare courses for people working in rabbit farms. Rabbit is part of Andalusia's gastronomic heritage.

#### HISTORY OF OUTDOOR RABBIT FARMING IN ITALY

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The essay summarises the story of the Teaching and Research Centre for Rabbit Welfare and Production currently established near Pisa (Italy). All models of breeding facilities are always outdoors. The first ones

were simple multiple self-built cages which, by preventing direct contact, afforded an excellent health condition. Later warrens were improved with shelters and nests freely chosen by the rabbits and a self-capture system was developed which allowed perfect management. To provide a natural defence against thermal stress, a very efficient shelter was subsequently developed consisting of a small cube of concrete or clay covered with earth and connected, via a pipe, to an external cage. This system has proven to be very simple and profitable and has been adopted by many small owners to supplement their income.

### HOUSING OF RABBITS WITHOUT CAGES: LIGHTS AND SHADOWS

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The Resolution of the European Parliament related to the European Citizens' End-the-Cage-Age initiative has started a revision process of existing legislation on animal welfare of farmed species in Europe, which will also reasonably impact rabbit production. Indeed, cage-free group housing systems have been under study since 1994 in growing rabbits and since 2006 in reproducing does, when the first papers appeared in a scientific journal (Scopus database). Now, a roadmap towards a transition is under definition in Europe, with consumers on one side asking for more animal welfare—due to different motivations—and farmers looking for economically viable strategies and internal motivations for performing the changes—for a satisfying socio-economic survival of their production. While external forces driving the change will likely result in the loss of rabbit production, researchers are working to highlight the advantages and disadvantages of cage-free systems, looking for technical solutions that can overcome the main challenges for farm production and animal health on one hand and looking for more knowledge about the rabbit behavioural and welfare requirements under farming conditions on the other.

### MAIN CHALLENGES IN THE RABBIT FARMING SECTOR

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The Spanish rabbit farming sector faces significant challenges: rabbit production and census have decreased,

while exports decline and imports increase. Domestically, consumption has decreased, partly due to rising prices and recipe unfamiliarity. Stricter European regulations, climate change and reduced fertility in warm months also threaten profitability and sustainability. This complex situation discourages new generations from entering the sector, forecasting future difficulties.

### ANIMAL MATERIAL AND DISEASE RESISTANCE

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This review aims to summarise different approaches that have been carried out for the genetic improvement of resistance to digestive, respiratory and viral diseases and resilience. For most of the traits studied, heritabilities are low. While disease resistance has been included in some breeding programmes, different strategies have been used to obtain responses to selection for resilience such as divergent selection or the constitution of lines with high selection pressures. Genomic and metagenomic tools are providing valuable information on the mechanisms involved in disease resistance and resilience. Keywords: Rabbit, genetic, pathology, resilience.

### NEW LEGISLATION IN VETERINARY FIELD, PECULIARITIES IN THE RABBIT FARMING SECTOR

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European regulations are driving a change in the way food is produced and managed, promoting smaller livestock operations with fewer antibiotics and agriculture with reduced use of fertilisers and pesticides. Agenda 2030 and the Farm to Fork Strategy exemplify this. The primary objective seems to be to reduce or even eliminate meat consumption. The publication of Regulations 4, 5 and 6 by the European Parliament in 2019, followed by implementation two years later, has sparked the creation of several National Royal Decrees, signifying a significant shift in the livestock industry. These decrees address aspects such as operator surveillance, comprehensive health plans, distribution of veterinary drugs and sustainable use of antibiotics.

## NUTRITION

### GROWTH, FEED EFFICIENCY AND CARCASS QUALITY OF GROWING RABBITS FED DIETS CONTAINING TWO PRODUCTS DERIVED FROM LINSEED PRODUCTION SUPPLEMENTED WITH TWO LEVELS OF VITAMIN E

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Growth, feed efficiency and polyunsaturated fatty acid profile (omega-6 and omega-3) were evaluated in fattening rabbits fed diets containing two novel products derived from flaxseed oil production. A total of 400 rabbits were distributed among the five experimental diets (CTL: control, PL-O: mixture of high fat flaxseed chaff and wheat flour (70:30); PL-E: PL+Vitamin E, HL-O: high fat extruded flaxseed meal, HL-E: HL+Vitamin E) at 36 d of age. At 71 d of age, 20 animals/diet were euthanised to quantify the fatty acid profile in the *longissimus dorsi* muscle. Growth ( $\approx 40$  g/rabbit/d), feed consumption ( $\approx 129$  g/d) and the health risk index (morbidity+mortality  $\approx 44.5\%$ ) were similar among the five diets. The proportion of omega-6 polyunsaturated fatty acids was higher in the CTL diet with respect to the other diets ( $\approx 2.0$  points). The diets containing PL and HL had a fatty acid profile with a higher percentage of omega-3 polyunsaturated fatty acids ( $\approx 3.7$  points) compared to the CTL diet, resulting in a higher omega-6/omega-3 ratio in the CTL diet relative to the other diets ( $\approx 4.3$  units).

### EFFECT OF THE INCLUSION OF SACCHARINA LATISSIMA, ULVA LACTUCA AND ITS EXTRACT ON PERFORMANCE IN GROWING RABBITS

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The aim of this study was to evaluate the effect of inclusion of dehydrated *S. latissima* (0.25%) and *Ulva lactuca* (1%), as well as an extract of the latter (0.04%), on productive performance in growing rabbits. To this

end, a control feed and three others in which algae were included were formulated. The iodine content of the feeds was 1.20 (control)-7.41-1.97-1.13 ppm, respectively. Two experiments were carried out in two farms (25 and 24 litters of 8 rabbits each/treatment) and in both it was necessary to medicate during fattening due to digestive problems (average mortality 17 and 9%, respectively). In this context, the algae products did not modify the incidence of mortality or main production performance. On farm A, from 61 to 65 d of age, there was a tendency to reduce feed intake in the algae-fed groups compared to the control group ( $P=0.064$ ), without affecting growth rate. This could explain why in the full fattening period the corrected feed conversion ratio (including the increase in body weight of the dead) tended to decrease in the same groups ( $P=0.12$ ). On farm B, from 33 to 54 d of age, the algae-fed rabbits tended to have an improved feed conversion ratio compared to the control group ( $P=0.065$ ). In the second fattening period, they reduced their growth rate compared to the control by 7% ( $P=0.038$ ). In both trials, the mean final weight of the young rabbits was also very similar between the different treatments. The iodine content of the dehydrated *S. latissima* diet did not affect performance.

### DEHYDRATED BANANA LEAF IN RABBIT DIET IMPROVES THE QUALITY AND OXIDATIVE STABILITY OF REFRIGERATED MEAT FOR UP TO 72 HOURS

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This study aimed to evaluate the meat quality, chemical composition and oxidative stability of rabbits fed increasing levels of dehydrated banana leaf (DBL). Forty New Zealand White rabbits (35 to 85 d) were used, distributed to cages in a completely randomised design, with four treatments (0.00; 3.33; 6.67 and 10.00% DBL) and 10 replicates. At 85 d of age, the animals were slaughtered to evaluate the quality characteristics, chemical composition and oxidative stability of the meat, for up to 72 h of storage under refrigeration (4°C). There was a linear increase in pH 45 min ( $P=0.017$ ) and pH 24 h ( $P=0.003$ ) due to increasing levels of DBL in the diet. There was a linear increase ( $P=0.081$ ) in the crude fat deposited in the carcass and a linear reduction ( $P=0.033$ ) in the crude protein, resulting in a linear increase in the fat:protein ratio ( $P=0.005$ ) depending on the increasing levels of DBL in the

diets. DBL levels increased ( $P<0.001$ ) the capture of 2,2-diphenyl-1-picrylhydrazyl (DPPH) and 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) radicals, and stopped the generation of thiobarbituric acid reactive substances (TBARS) in meat, indicating an improvement in antioxidant levels, while the evaluation days reduced ( $P<0.001$ ) the capture of DPPH radicals and ABTS and increased the generation of TBARS. The inclusion of up to 10% of DBL increases the percentage of fat in the carcass of New Zealand White rabbits, but stops the sudden drop in pH of the meat 45 min and 24 h after slaughter and improves the antioxidant levels, promoting the shelf life.

### INFLUENCE OF THE TYPE OF ORGANIC ACID AND ADMINISTRATION ROUTE ON THE PRODUCTIVE PERFORMANCE AND HEALTH OF POST-WEANING RABBITS

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The aim of this study was to evaluate the effect of the type of organic acid (OA) and the administration route (water vs. feed) on performance, mortality and modulation of the gastrointestinal environment in post-weaning gilts. Seven experimental treatments were used, in which three organic acids (formic, acetic and citric) administered via drinking water and feed were tested, as well as a negative control, without the addition of OA. The study was conducted with 1624 weaned rabbits divided into 4 batches, with a duration of 29 d per batch. In each batch, the animals were distributed in the seven experimental treatments in both individual cages (64 replicates per treatment) and group cages (28 replicates per treatment with 6 animals/replicate). All animals were fed *ad libitum* with a commercial feed during the test. The AO treatments in the drinking water were dosed to reach pH=4. The concentration of AO in the feed treatments was calculated to equal the amount of AO ingested via the water. Mortality was determined daily in all animals. At 43 and 57 d of age, in each batch, all animals were individually weighed and feed consumption was recorded. On these days, 6 animals per treatment, day and batch were sacrificed and pH was measured along the gastrointestinal tract (fundus,

antrum, duodenum, jejunum, ileum and cecum). The results indicate that the inclusion of OAs in the water improved the productive performances during the first growth period (29 to 43 d) and the overall period, compared to the addition of OAs in feed. The addition of any of the tested OAs administered via water could be suitable for application in rabbit farming, since they improved liveweight, weight gain and average daily feed intake (formic acid), average daily gain and feed conversion ratio (citric acid) and feed conversion ratio (acetic acid) overall, with respect to the control group. The addition of AO did not change the pH along the gastrointestinal tract compared to the control group. Further research is needed to evaluate its effect on mortality.

### IN VITRO ANTIMICROBIAL POTENTIAL OF BIOACTIVE COMPOUNDS AGAINST ENTEROPATHOGENIC BACTERIAL STRAINS IN RABBITS

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In this work, the *in vitro* antimicrobial potential of a total of nine antimicrobial compounds (five essential oils - thymol, eugenol, carvacrol, cinnamaldehyde and vanillin - and four organic acids – butyric, caprylic, capric and lauric) was evaluated against six pathogenic strains highly prevalent in young rabbits with digestive disorders (*Escherichia coli* 0103, *E. coli* 0109, *E. coli* 026, *Clostridium perfringens*, *C. spiroforme* and *Bacteroides fragilis*). First, the disc-plate antibiogram method was used in triplicate to determine the antimicrobial susceptibility of the six strains against each of the nine compounds. Second, the bioactive compounds with the highest inhibition of bacterial growth were tested in quadruplicate by the broth microdilution method to determine the minimum inhibitory concentration (MIC) and bactericidal concentration (MBC). The results showed a higher antimicrobial effect of essential oil compounds compared to organic acids against enteropathogenic rabbit strains. However, the different strains presented different susceptibilities to the compounds.

## GENETICS

### RELATIONSHIP BETWEEN THE BIRTH WEIGHT OF THE KIT AND ITS SURVIVAL IN THE FIRST DAYS OF AGE

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Kit survival in the first hours of life has been related to the weight of the kit at birth. The aim of this study is to assess the effect of the line, the physiological status of the doe, the season of birth, sex, milk intake and kit weight at birth on kit survival at birth and at first week of life. The kits that died at birth weighed 28% less than those that were born alive (-13.7 g). In the first week of life, the kits increased their weight by 55% compared to birth weight (48.9 g). A relevant effect of the line, the doe's physiological state and the kit weight at birth on its survival in the first hours of life is reported, while the line, milk intake and kit weight at birth are the factors that determine kit survival in the first week of life.

### ESTIMATION OF GENETIC PARAMETERS OF RABBIT WEIGHT IN PREWEANING PERIOD

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Prewaning mortality has been related to kit weight, therefore kit weight in the first days of life may be a trait of interest in breeding programmes. However, more knowledge of its genetic determination is needed. In this study, we analysed the weights of 1696 kits from the synthetic line ITLEV2006 to estimate genetic and non-genetic parameters of kit weight at birth, 5, 7, 14, 21, 28 and 35 d of age. The estimated values of heritability ( $h^2$ ) for individual weights ranged from low (0.11, 0.16 and 0.17 at birth, 5 and 7 d, respectively) to moderate (0.21, 0.21, 0.24 and 0.21 at 14, 21, 28 and 35 d, respectively). Birth weight showed a large and positive genetic correlation with weight at 5 d (+0.79) and 7 d of age (+0.78), but low with all other weight measures

(+0.41, +0.49, +0.54 and +0.54 with weight at 14, 21, 28 and 35 d, respectively). Weight at 5 days and 7 days displayed large and positive genetic correlations with the rest of the weight measurements ( $>+0.83$ ). Common litter effect values ( $c_2$ ) were high and increased with animal age from 0.43 at birth to 0.66 at 35 d of age. Maternal standing effect ( $p_2$ ) values were low compared to those of the common litter effect ( $c_2$ ), ranging from 0.04 to 0.11. In conclusion, selection by kit body weight at 5 or 7 d of age would have a greater response than that of birth weight and would indirectly increase the kit weight at weaning and at birth, as well as reducing preweaning losses.

### LONGITUDINAL STUDY ON RABBIT GUT MICROBIOTA VARIATION THROUGH AGE AND ITS RELATION TO LONGEVITY

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This study investigates the gut microbiota evolution through the age of two rabbit lines with different longevity (LP, a line founded with longevity criteria, and A, a standard commercial line). To do so, the bacterial gene 16S rRNA was sequenced in 368 soft faeces samples collected from 195 does (78 of line A and 117 of line LP). After filtering and quality control, the sequences were analysed using DADA2 in R. Taxonomic annotation, alpha and beta diversity metrics were computed with QIIME2 software. The diversity analysis reveals changes in microbial diversity with increasing age and shows that older does have lower alpha diversity indices (Shannon and Pielou Evenness) than younger ones. Principal Coordinate Analysis (PCoA) graphs based on beta diversity distance matrices (Bray Curtis, Jaccard, weighted and unweighted Unifrac) show clear gradual separations between samples with increasing age. Further studies will be carried out to investigate how microbial abundance changes over time between the two lines A and LP and its possible implication in longevity.

### PRELIMINARY ESTIMATES OF RESPONSE TO SELECTION FOR FEED EFFICIENCY IN THREE MEAT RABBIT LINES

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The three lines were selected to increase their post-weaning feeding efficiency, but different criteria were used in each of them, all based on records of animals reared in group. The RFI line was selected to reduce residual feed intake measured individually with electronic feeders, the GRP line to reduce the residual feed intake but measured as a cage average, and the ADGR line to increase growth in animals fed under restriction, which was applied using electronic feeders, limiting daily access to feed to the time slot 18:00-06:00. The results showed that, compared to a control population established from vitrified embryos six generations ago, the RFI and GRP lines presented a decrease in weight at the end of fattening of between 15 and 25 g per generation. This decrease is mainly attributed to a reduction in daily growth, with values of  $-0.82$  and  $-0.40$  g/d/generation for RFI (measured with conventional and electronic feeders, respectively) and  $-0.57$  and  $0.37$  g/d/generation for GRP. However, these differences are attenuated when adjusted to a constant live weight (LW) of 2 kg. The evaluation of consumption was only carried out in animals fed using electronic feeders, observing that at 2 kg LW, the RFI and GRP lines consumed less food than the control population, with reductions of  $-2.05$  and  $-1.53$  g/d/generation, respectively, with only the decrease in the RFI line being significant. This suggests an improvement in feed conversion ratio of  $-0.04$  points per generation in the RFI line. Genetic selection to improve feed efficiency using electronic feeders to monitor feed consumption is a viable strategy, which can contribute to significantly improving the sustainability and profitability of rabbit production.

## A NEW LINE SELECTED FOR FEED EFFICIENCY. 2. RESIDUAL FEED INTAKE, METABOLIC WEIGHT AND MAINTENANCE ENERGY

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The relationship between the metabolic weight used to correct the selection criteria 'residual feed intake' and 'residual growth' and several productivity variables of the reproductive female are examined. There is no relationship between this metabolic weight and the number weaned

from the second parity, total number of weaned, longevity of the doe, average interval between parities, total productivity and productivity per time unit (total number of weaned / interval between first and last parity) or body condition (perirenal fat content at second parity); or the correlation is very low. In conclusion, it does not seem to be justified to correct for metabolic weight, taking into account that the variance of the trait decreases due to the correction by metabolic weight and consequently the response to selection could be lower.

## REPRODUCTION

### EFFECT OF ADMINISTRATION OF THE FLAVONOID QUERCETIN ON OVULATION RATE, FEED INTAKE AND BODY COMPOSITION IN YOUNG AND ADULT RABBITS DOES

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The use of antioxidants such as quercetin (QR) has a great interest in improving reproductive function and lifespan in rabbits does. To assess the effects of this flavonoid on these parameters, a study was conducted with young (group J) and adult (group A) does to which QR (300 mg/kg) (JQ and AQ) was administered orally for 8 wk and compared with does not treated with QR (JC and AC). Body weight, feed intake, body composition (% fat, water, ash, protein and energy [kJ/100g]) and reproductive parameters (mean ovarian weight, number of corpora lutea [CL], ovulation rate, recovery rate and serum progesterone levels [P4]) were measured. The results showed that QR administration did not influence the growth and body weight maintenance of young and adult rabbits does. Body composition was affected by age (young or adult), with a higher protein and water content in adult does and a tendency to increase body fat content in JQ. Ovarian weight was higher in adult rabbit does. Ovulation rate was 100%, and the number of CL was similar for all the groups. Nevertheless, higher P4 levels were observed in adult does than in JC does, showing intermediate levels in JQ does. In conclusion, QR administered for 8 wk could be improving energy reserves and P4 production in young does.

### EFFECT OF THE INSERTION DEPTH OF THE INSEMINATION CANNULA ON THE FERTILITY AND PROLIFICACY OF NON-LACTATING RABBITS WITHOUT THE USE OF GnRH ANALOGUES

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When performing Artificial Insemination (AI) in rabbits, ovulation induction typically relies on the administration of GnRH analogues. However, it has been observed that some females exhibit ovulatory responses to physical stimuli, such as insertion of the insemination catheter. The aim of this study was to determine how the depth of the catheter affects ovulation stimulation, ovulation rate and litter size. The results demonstrated that ovulation induction and, consequently, fertility at birth were significantly higher when the catheter was inserted to a depth of 15 cm compared to 5 cm, reaching a 65% birth rate and litter sizes similar to the control. Therefore, it is possible to conclude that the introduction of the catheter is responsible for a high percentage of non-lactating rabbits ovulating without the need to use exogenous endocrine factors, and it is likely that the type of catheter, depth and mode of insemination will allow for the future elimination or reduction of the group of inseminated rabbits that need to be stimulated to ovulate through GnRH analogues, improving animal welfare and increasing AI biosecurity.

## HOUSING AND ANIMAL WELFARE

### PRODUCTIVE AND SANITARY IMPACT OF HOUSING FEMALES IN COLLECTIVE PARCS

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The productivity and sanitary status in rabbit does in a handmade park was tested. A total of 4 parks (5 places per park) where constructed from 4 modules of 5 cages with platform, by removing the ceilings, enlarging the walls, covering 80% of the flat with plastic grid foot rest, and cutting walls between places of the same park to enable a trapdoor that would allow/restrict movement between places. For 6 reproductive cycles, 20 females were allocated in 4 parks (5 females per park; group P) and 20 in individual cages (group J). All the females were

inseminated at 11 d postpartum and weaned at 35 d postpartum. In group P, the trapdoor was closed between 7 d prepartum and 7 d postpartum, to house individually the females during peripartum. Group P had, in general, lower results in fertility (from 21.1 to 85.0% in group P vs. from 66.7 to 100% in group J), number of born alive per kindling (from 7.26 to 9.86 in group P vs. from 8.06 to 12.5 in group J), and number of weaned per kindling (from 4.72 to 8.45 in group P vs. from 7.79 to 8.50 in group J). Moreover, at the end of the study, females in group P had lower sanitary status, with low weight in 40.0% of the females vs. 6.7% in group J. Results show that the park affects negatively both productivity and health status of the rabbit does.

### RISKS OF COLLECTIVE HOUSING OF PREGNANT FEMALES IN ENRICHED PARKS

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In the current societal landscape, there is an escalating concern for the welfare of farm animals. This trend was manifested in the ratification of the “End of the Age of the Cage” Citizen’s Initiative by the European Parliament in June 2021, underscoring the need for innovative rabbit breeding models that circumvent the use of cages. In this milieu, our study was focused on assessing the impact of communal housing of breeding females in enriched pens on their behaviour, welfare and reproductive efficiency. A pen spanning 5.6 m<sup>2</sup>, equipped with slatted floors and PVC walls, was constructed. This enclosure housed four females and one male as a family group across four birthing cycles. Notably, no signs of aggressive behaviour such as injuries or paw lesions were observed. An enhancement in female socialisation was noted, yet dominance behaviours also surfaced, leading to extended intervals between successive births. The litter size was akin to that of conventional cages (10.1±0.67 vs. 9.2±0.67). No significant differences were detected in the weight of the young or in mortality rates. The average productivity per female rabbit was 8.9 kits in the pen vs. 10.2 kits in the cage. In conclusion, a pen providing 1.12 m<sup>2</sup> per animal is capable of achieving a mean productivity per rabbit comparable to that under a semi-intensive regime in conventional cages.

## A MOBILE VARIANT OF THE ITALIAN UNDERGROUND CELL SYSTEM TO INTEGRATE RABBIT KEEPING IN ORCHARDS

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The possibility of improving the family rabbit production by integrating it into fruit trees orchards has been investigated. To achieve this, each traditional underground cell of the Italian model was placed inside a wide plastic pallet box instead of between two stone or brick walls, each one becoming easily movable by means of a forklift. In this way, the efficient Italian open-air underground cell system that is adopted by many small producers for income integration became mobile. The new units were located in the shade of apricot trees and, throughout the summer of 2022, the maximum and minimum temperatures were measured both in the surrounding environment and inside two movable cells. Temperature was the only important experimental factor, since the perfect functionality of the system was already well known, but not the thermoregulatory efficiency of the cell, which could be diminished when inserted into the containers that also now received the ambient heat through all four walls and could leave the rabbits exposed to the thermal stress of summer. The results indicate that the insulation effect of the cell was very effective, remaining 15°C lower than the maximum external temperature, never exceeding 28°C for more than a limited time. In the summer of 2023, it was also found that the thermo-protective effect of movable cells is comparable to that of traditional fixed cells and the results indicate that the new prototypes of movable underground cells are functional and can already be tested in integrated production trials.

## BEHAVIOUR OF NEW ZEALAND WHITE DOES DURING LACTATION PHASE AND PERFORMANCE OF RABBIT KITS IN BRAZIL

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Considering the importance of the initial development period of rabbit kits for the prosperity of the production system, the aim of this study was to evaluate the behaviour of New Zealand White does during the lactation

period (1 to 36 d) and the performance of the kits in a commercial production system. Nine does with 8 kits each were used and a monitoring camera was installed to carry out behaviour analysis. Six consecutive 24-h monitoring sessions were carried out, on days 2, 8, 15, 22, 29 and 36 of nursing. The maximum active nursing recorded was on day 2, corresponding to 0.66% of the 24-h period (around 9 min), but fell to 0.37% of the total time (around 5 min) from 8 lactation days. Does spend postpartum most of their time idle or self-grooming. Milk consumption by kits increased with age, being proportional to weight gain, reaching its maximum at 20 d of life and gradually decreasing shortly thereafter. In conclusion, rabbits in the postpartum period spend most of their time idle or self-grooming. During nursing, there is a reduction in visits to the nest and active nursing over time, associated with an increase in passive nursing. The growth of kits is directly proportional to milk consumption during the first three weeks of life.

## ACUTE STRESS RESPONSE WITH AND WITHOUT THERMAL STRESS BY INFRARED THERMOGRAPHY ON THE EYEBALL

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The present work studied the evolution of eyeball temperature measured with infrared thermography in 90 male rabbits belonging to two lines selected divergently for litter size variability. Data were collected before and after sperm extraction, with and without thermal stress, at 3 moments distributed over 5 min (0, 1 and 5). The extraction was carried out after measuring the basal temperature at minute 0. The duration of the experiment was 9 wk. Without thermal stress, no differences were found between the lines and the reaction to the stimulus caused by sperm extraction was identified at minute 1. With thermal stress, the basal temperature of the low line (37.66°C) was lower than that of the high line (37.92°C). The high line did not respond to the stimulus. In the low line, the response was identified at minute 5 and always remained below the levels recorded in the high line. In conclusion, without thermal stress the lines seem to behave in a similar way, although with thermal stress the low line has a greater capacity to adapt to the environment.



## PATHOLOGY

### ASSESSMENT OF THE EFFICACY OF YURVAC<sup>®</sup> RHD AGAINST DIFFERENT STRAINS OF RABBIT HAEMORRHAGIC DISEASE

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Vaccination against rabbit haemorrhagic disease (RHD) is the primary means of protection against this disease. For this reason, YURVACR RHD, the new recombinant vaccine indicated for active immunisation of rabbits from 30 d of age onwards, has been developed to reduce mortality from RHD caused by the classic RHD virus (RHDV) and variant strains (RHDV2), including highly virulent strains. The aim of this study was to demonstrate the efficacy of YURVACR RHD against RHD. The active substance of the vaccine consists of a recombinant capsid protein of the RHD virus, corresponding to VP60. The antigen was obtained using recombinant DNA technology. All the efficacy studies followed the same structure: one group of animals vaccinated with YURVACR RHD and a control group given PBS. In order to demonstrate both the onset and duration of immunity against each strain, all the animals were challenged at 7 or 14 d and 1-yr post-vaccination. In all cases, the animals were seronegative at the time of vaccination. The serological response was evaluated using the haemagglutination inhibition technique to detect antibodies against RHD. A duration of immunity of 1 yr was confirmed for RHDV, RHDV2 and highly virulent RHDV2 strains. The onset of immunity was established at 7 d for RHDV2 and highly virulent RHDV2 strains, and at 14 d for RHDV. The results confirmed the efficacy of YURVACR RHD against RHDV, RHDV2 and highly virulent strains of RHDV2.

### SAFETY EVALUATION OF YURVAC<sup>®</sup> RHD IN YOUNG RABBITS, PREGNANT FEMALES AND LACTATING FEMALES

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YURVACR RHD is the new recombinant vaccine against rabbit haemorrhagic disease (RHD), indicated for use in rabbits, including young rabbits and pregnant and lactating does. The objective of this study was to demonstrate that YURVACR RHD is safe when administered to the target species and does not affect productive and reproductive parameters. All the safety studies followed the same

structure: one group of animals vaccinated with YURVACR RHD and a control group given phosphate-buffered saline. Two preclinical studies were conducted, one in pregnant does and another in lactating does, along with a field study in young rabbits housed on 2 commercial farms in France. In all cases, local and systemic reactions, rectal temperature and reproductive and productive parameters were evaluated in accordance with the study protocol. In the safety test with pregnant does, the results show that none of the does had compromised health status attributable to the vaccine. In the safety test with lactating does, the results show that vaccinating with YURVACR RHD does not affect the reproductive function of the females or the health of their progeny. In the field study with young rabbits, none of the animals showed general clinical signs. Regarding local clinical signs, 23% of the animals presented inflammation <2 cm 24 h after vaccination. This local reaction gradually decreased and disappeared in all animals after 1 week without the need for treatment. In conclusion, the results confirm that YURVACR RHD is safe when administered to pregnant does, lactating does and young rabbits.

### FOUNDATION OF NEW PATERNAL LINES: A STUDY OF THE IMMUNE SYSTEM

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This study evaluated the percentage of leukocytes and immunological parameters at weaning in female rabbits and their kits from three genetic lines (R, RF and RFLP). The R line was selected for a high growth rate during the fattening period for 37 generations, the RF line was founded through a high-intensity of selection of elite animals from the R line, and the RFLP line, which was obtained by backcrossing RF animals with the LP line (a long-living-productive maternal line, characterised by high robustness). Females from R line showed higher percentages of monocytes than the RF (+2.1 percentage points;  $P < 0.05$ ). Kits from R line had a lower percentage of T and CD4+ lymphocytes than the RF line (-8.1 and -6.1 percentage points, respectively;  $P < 0.05$ ) and a lower percentage of CD25+ than RFLP (-0.8 percentage points;  $P < 0.05$ ). Correlations were observed between leukocyte populations in females and kits at weaning.

The results suggest that the introduction of robust genetics by backcrossing into rabbit paternal lines may have improved the immune status of the rabbit does and their litters.

### CURRENT STATUS OF STAPHYMAP: DISTRIBUTION OF CLONES, ANTIMICROBIAL PROFILES AND VIRULENCE

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The analysis of 635 strains of *Staphylococcus aureus* obtained in Spain revealed a predominance of CC121, followed by CC96, together representing almost 90% of the strains studied. However, an increase in the presence of other clonal complexes such as CC5, CC398 and CC130 was observed compared to previous studies. Correlations between the severity of the lesion and virulence genes were identified, indicating adaptation to different environments and pathologies. Additionally, differential genes between clonal complexes were observed, which could offer new insights into the virulence of the bacteria and potential therapeutic targets. The high proportion of multi-resistant strains underscores the urgent need for antimicrobial management strategies. These results highlight the importance of continuous surveillance of antibiotic resistance and virulence in *S. aureus*, as well as the adaptation of prevention and control strategies to the genetic and epidemiological characteristics of circulating strains.

### GENOMIC PERSPECTIVE: PANGENOME AND PHYLOGENY OF *STAPHYLOCOCCUS AUREUS* IN RABBITS

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The Spanish rabbit farming industry plays an essential economic role, encompassing the production of rabbit meat, skin and fur. However, the presence of *Staphylococcus aureus* poses critical challenges, leading to significant economic losses due to various pathologies in rabbits. This study focuses on the phylogeny and

pangenome of 245 strains isolated from different farms in Spain, emphasising the importance of clonal complexes such as CC121 and CC96. These complexes exhibit differences in virulence and antibiotic resistance, playing a crucial role in the intricate phylogeny of *S. aureus* in rabbit farming. The study delves into the relevance of *S. aureus* as a model organism in genomic and molecular research, providing insight into the dynamic evolution of strains. The research reveals high genomic variability, with over 40% of unique genes in some strains, particularly related to clonal complexes. Statistical analysis indicates significant differences between clonal complexes, highlighting the influence of differentiation events since the 1960s, coinciding with the industrialisation of rabbit breeding in Spain. These results offer a profound understanding of the genomic dynamics of *S. aureus* in Spanish rabbit farming, with key implications for control and prevention strategies. Dating of nodes in the phylogenetic tree reinforces the temporal relevance of these events, contributing to the identification of new treatment strategies.

### EXPLORING THE MOBILOME OF *S. AUREUS* ISOLATES FROM RABBITS

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*Staphylococcus aureus* is remarkable for its genetic plasticity, which facilitates the acquisition of resistance and virulence. The increase in staphylococcal cases in rabbit farms suggests that strains could be developing new resistance and virulence mechanisms potentially located in mobile genetic elements (MGEs). Analysis of MGEs revealed that the strains presented mainly bacteriophages and plasmids. Pathogenicity islands (SaPIs) had a limited presence and were not associated with the predominant clonal complexes (CC121 and CC96). Analysis of the number of MGEs per strain revealed that CC96 has more MGEs than CC121. Subsequently, some of the most frequent resistance genes were selected to assess their mobility by generalised and lateral transduction. The results, although still preliminary, suggest that these genes could be mobilisable and would emphasise the importance of continuing to monitor this type of genetic transmission between bacteria.

## PRODUCTS

### RECEPTIVITY OF UNIVERSITY STUDENTS TO THE CONSUMPTION OF RABBIT MEAT. PRELIMINARY RESULTS

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We studied the receptiveness of students at the University of Trás-os-Montes and Alto Douro to the consumption of rabbit meat through online surveys, 252 of which were considered valid. Most respondents were female (62.7%) and only 7% of students reported habitual contact with livestock. The consumption of rabbit meat by university students (79.2%) mainly takes place at home (87%) and with animals of family origin (48.5%). Among the options for motivating consumption, 45.5% say they enjoy the meat and the sustainability factor is not highly valued (6%). The reasons for not eating rabbits are related to their association with pets (52%) and organoleptic issues (64%). To change the consumption habits of these young students, none of the respondents valued the price issue and only 8% admitted that they would do so if it were produced organically or with a different presentation. The consumption of rabbit meat among the young university students in the sample is based on fragile principles, as the majority only consume it in a family environment and in traditional production. The young students who do not consume it have no desire to do so.

### EFFECT OF AGE AND COOKING METHOD ON EDIBLE YIELD OF RABBIT MEAT

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Meat characteristics vary depending on age at slaughter. The aim of this work was to evaluate the effect of age at slaughter on cooking losses and edible yield of rabbit meat subjected to three cooking methods (boiled, roasted or fried). The carcasses of 18 male rabbits (63, 70 and 77 d old) were divided into six pieces and subjected to the 3 aforementioned methods. After preparation, the samples were cooled to room temperature for 30 min and weighed to calculate cooking losses. The edible yield was obtained and calculated after cooling the piece and removing the bone. A significant increase in the weight of the pieces made with age was observed. Meat from older rabbits had lower cooking losses and lower edible yields. In cooking losses, the values varied between 25.5% in the cooked piece of rabbits aged 77 d and 36.9% in fried meat from rabbits aged 63 d. Although the cooking method does not affect the edible yield, boiled rabbit meat pieces suffered fewer losses ( $P < 0.05$ : 27.5%) compared to roasted or fried ones (31.0 and 33.9%, respectively). Cooking losses and edible yield were higher in meat from younger rabbits. Cooking losses are lower when the meat is boiled, but the method does not affect the edible yield.