

ABSTRACTS OF THE 5TH AMERICAN RABBIT CONGRESS

TOLUCA, ESTADO DE MÉXICO, MEXICO, SEPTEMBER 8-11, 2014

The 5th American Rabbit Congress was held in Toluca, Mexico State, Mexico from September 8th to the 11th, 2014. Research works representing 14 countries were accepted to take part at the congress, including papers from Algeria, Argentina, Brazil, China, Costa Rica, Cuba, Egypt, France, Hungary, Italy, México, Uruguay, the USA and Venezuela. These research works highlight the enormous interest, effort and commitment of the scientific community that bonds the trinomial of Research+Innovation+Technology Transfer, in favour of the integral development of rabbit rearing as an important primary activity that generates permanent employment, as well as healthy and nutritive meals for their respective countries for the XXI Century World. One major impact at this 5th American Rabbit Congress was the participation of Argentina, Brazil and China. The latter country's report was presented by Laping Wu and Dong Wang (2014), showing that from 2005 to 2010, meat production of swine, beef and poultry underwent average growth of 2.6%, whereas rabbit meat production reported an annual average growth of 6.29%, reaching an annual volume of 761 000 tons, positioning China as the world's main rabbit meat producer. This data highlights the great potential of rabbit production, both as an economic activity and a key strategy in the fight against hunger and poverty in many countries all over the world. During the congress, scientific works were presented related with the fields of Ethology, Housing & Welfare; Genetics; Reproduction; Digestive Physiology and Basic Nutrition; Feed Evaluation and Feeding; Pathology & Hygiene, Meat Quality, Safety & Dining; Management, Social & Economy. Furthermore, the meeting of the AB-WRSA chaired by the AB-WRSA founder, Dr. Steven Lukefahr, also took place at this congress, in which the new board of the American Branch was elected and the proposal put forward for the next American Rabbit Congress to be held in Costa Rica. Finally, at the post-congress, a course-workshop on rabbit meal rationing was given by Dr. Luiz Carlos Machado, and 6 conferences were held on the new opportunities for rabbit feeding and meal production.

MAIN PAPERS

THE SMALL-SCALE RABBIT PRODUCTION MODEL: A GUIDE TO HUMAN DEVELOPMENT

LUKEFAHR S.D.

Dept. of Animal, Rangeland and Wildlife Sciences, MSC 228,
Texas A&M University, KINGSVILLE, TX 78363, USA.

s-lukefahr@tamuk.edu

One of the challenges in developing successful meat rabbit projects for people living in poverty (representing about half of the human population) is the reality that many factors must be considered. Across countries and cultures, some factors are very critical (e.g., suitable breeds, feedstuffs, housing, marketing, and training methods); however, in others the choices or decisions may be very different. The implication is that there are very few, if any, general recommendations that are appropriate for all situations. The impetus for developing the Small-Scale Rabbit Production Model (SSRPM) was to serve primarily

as a tool for project managers to address key issues, especially when planning and implementing projects. In brief, for the sake of simplicity the model is divided into 3 dimensions: internal, intermediate, and external aspects, which relate to farmers, project managers, and the environment, respectively. At the internal level, farmers make decisions on the appropriate choice of breed-types, feedstuffs for diets, materials for housing, etc. In contrast, at the intermediate level, managers (i.e., usually representing a development organisation) embrace the project components of feasibility, design, implementation, monitoring, and evaluation, all of which guide or direct the project. This includes setting a clearly defined project goal with specific objectives. The external level of the environment encompasses ecological, market and social aspects. In other words, to be successful the rabbit project must benefit the environment, increase farmers' income, and be supported at every stage by the local community. Of course, there should be a great degree of flexibility when applying the SSRPM. However, there are also certain

basic essentials such as farmers receiving training from a competent expert (ideally on demonstration farms), frequent on-farm visits following training, rabbit production being sustained on small farms with minimal off-farm inputs, regular family consumption of rabbit meat, record keeping, and active markets for surplus rabbits. Another key aspect is the training and development of local farmer leaders who will ultimately continue the project after phase-out, so that the project has a multiplication effect by spreading to other communities over time.

ORGANISATION AND STRATEGIES OF BRAZILIAN RABBIT PRODUCTION - A SEARCH FOR SOLUTIONS

MACHADO L.C.*, FERREIRA W.M.†

*Professor Minas Gerais Federal Institute - Bambuí Campus – Brazil. †Professor Minas Gerais Federal University – Brazil.

luiz.machado@ifmg.edu.br

Brazil is an emerging country with great potential for rabbit production. However, the history of this activity has been marked by ups and downs. The Brazilian rabbit population has decreased over the last few years, despite the considerable rise in the number of pet rabbits. It is not possible to estimate the exact amount of meat produced, as most of it takes place in informal conditions. We know that the demand for meat outstrips the supply. Pet rabbit production has grown in recent years and attracted the interest of new breeders, with a huge market to be explored, considering items and services for pet rabbits. Many institutions are now researching and teaching rabbit science, and it has been noted that several renowned researchers are retiring and new researchers are needed. There are over 40 rabbit feed factories, but few present quality and good prices. There are many problems that affect Brazilian rabbit breeders, with emphasis on the lack of specific public policies to support this activity, the work of breeders without organisation, the need to improve the available genetic material, the lack of slaughterhouses and meat processing plants, the dearth of specialists in rabbit production, the shortage of good quality materials and equipment, the lack of public information on the nutritional quality of rabbit meat and the high price of meat to the final consumer. Moreover, Brazilian law on slaughterhouse facilities is extremely strict. Actions have been taken by the Brazilian Rabbit Science Association (ACBC), such as the creation of discussion groups in the internet with the aim of enriching the dialogue, the publication of a new webpage to disseminate technical information and activities, the organisation and distribution of a CD with publications, the development of teaching materials such as feed formulation manuals and supplements for rabbits, a publication with applied rabbit production and technical notes, events such as rabbit production mini courses,

a rabbit breeder day, national science and technology seminars in rabbit science, or the creation of a national magazine. Information and support for rabbit breeders and people interested in the subject, encouragement for the formation of cooperatives and breeder associations and the institution of an award for professional achievement. Alongside these actions, the implementation of courses for initial and ongoing training in rabbit production and the divulgation of this activity have been planned, highlighting its benefits to society and the development of explanatory videos via Internet. In the last two years, an increase in demand for meat production has been noted. Organisation of the industry should be prioritised so that dialogue can occur and the management of buying and selling can take place through a proper channel.

GENETICS

PERFORMANCE OF NEW ZEALAND WHITE, CALIFORNIAN, CHINCHILLA AND BLACK AZTEC RABBITS AT THE CENTRO NACIONAL DE CUNICULTURA, MEXICO

MAGAÑA R.J.J*, GUERRERO C.E.M*, ALBERTOS A.P.J.*, MENDOZA C.M.*, MARTÍNEZ Y.R.*, PARADA H.R.†

*Departamento de Agronomía, División de Ciencias de la Vida, Universidad de Guanajuato. †Centro Nacional de Cunicultura, México.

rosario.mtzy@gmail.com

At the Centro Nacional de Cunicultura (CNC, México) post weaning growth was evaluated comparatively. According to CNC managers, no new breeder animals have been introduced in the last 20 yr, mainly as a result of sanitary barriers. Therefore, it is important to conduct performance evaluations of their animals. The evaluated breeds were New Zealand White, Californian, Chinchilla and Black Aztec; the evaluations were performed at CNC, Mexico's premises. A total of 240 just weaned rabbits (35 d) were used, 60 rabbits per breed, 50% females and 50% males, which were individually tattooed for identification and kept in cages (90×60 cm, 6 specimens per cage). Daily (9:00 a.m.), a kilogram of commercial rabbit feed was supplied. All animals were weighed weekly and slaughtered at 70 d of age. Weaning weight, weight at 70 d, feed efficiency, feed intake and specific growth rate (SGR) were evaluated. In weaning weight values for Black Aztec, New Zealand White, Californian and Chinchilla breeds, the means±standard error were 0.831, 0.815, 0.749 and 0.697±0.002, respectively. For weight at 70 d, 1.598±0.024, 1.800±0.023, 1.801±0.023 and 1.776±0.025 kg, respectively. The means for feed efficiency were 0.271±0.006, 0.289±0.006, 0.315±0.007 and 0.315±0.007 kg gain/

kg feed, respectively. For the variable SGR 2.00 ± 0.05 , 2.32 ± 0.05 , 2.45 ± 0.04 and 2.53 ± 0.05 % animal per day following the breeds order mentioned above. Chinchilla can still be considered a dual purpose breed. We cannot rule out the Black Aztec breed for meat production, and further research on productive behaviour is needed.

DIRECT AND MATERNAL ADDITIVE EFFECTS AND HETEROSIS IN PROLIFICACY WEANING TRAITS IN RABBITS

GARCÍA H.Y., PONCE DE LEÓN S.R., GUZMÁN M.G., FRAGA B.L.

Institute of the Animal Science. Carr. Central km 47 ½, San José de las Lajas, MAYABEQUE, Cuba.

yoleisyg@ica.co.cu

Evaluation of F₁ combinations in an environment with hot climate and nutritional limitations was required in order to establish an objective genetic improvement programme. Three complete diallel crossbreeding trials were performed between 1968 and 2005, involving 5915 weaning records of 4 rabbit breeds (California [C], Chinchilla [Ch], New Zealand [N] and Semi-giant White [S]) to determine direct (as an indicative of higher paternal breed) and maternal (best maternal breed) additive effects and heterosis in prolificacy traits at weaning in rabbits: proportion of litters weaned, number weaned and viability. A generalised linear mixed model (macro for GLIMMIX of SAS) was applied which considered the fixed effects of genotype (16 classes) and experiment (3 trials) and the random effect of parity (5 levels). Genetic effect estimations were done applying linear contrasts between means of the genetic groups after Dickerson's (1969) model. Maternal additive effects were more important (significant in all traits analysed) than direct effects and demonstrate the superiority of New Zealand over Chinchilla and Californian breeds. Direct additive effects were favourable for the Chinchilla breeds. Heterosis averaged 10.0, 8.8, and 13.0% for the 3 traits resp. and was significant and positive in 61% of the analysis. Maximum heterosis (13-17%) was found for the reciprocal pair of crosses: NS, CCh, ChS and CS. Results support simple crossing as a rapid and effective method of genetic improvement for suboptimal conditions.

CARCASS INDEX OF NEW ZEALAND WHITE, CALIFORNIA, CHINCHILLA AND BLACK AZTEC AT CENTRO NACIONAL DE CUNICULTURA, MEXICO

MARTÍNEZ Y.R.*, MAGAÑA R.J.J.*, GUERRERO C.E.M.*, ALBERTOS A.P.J.*, PARADA H.R.†

*Departamento de Agronomía, División de Ciencias de emerged Vida, Universidad de Guanajuato. †Centro Nacional de Cunicultura, México.

rosario.mtzy@gmail.com

The rabbit carcass index from animals at the Centro Nacional de Cunicultura (CNC, México) was evaluated comparatively. According to CNC managers, no new breeder animals have been introduced in the last 20 yr, mainly as a result of sanitary barriers that have emerged over the years. Therefore, it is important to conduct performance assessments of animals and carcass index evaluations. The breeds assessed were New Zealand White, California, Chinchilla and Black Aztec; the evaluations were conducted in CNC, Mexico's premises. 240 just weaned rabbits (35 d) were used, 60 rabbits per breed, 50% females and 50% males, which were individually tattooed for identification, all kept in American traditional type cages (6 specimens per cage). Carcass weight and yield, and quartering hot carcass weight (forelimbs, hind limbs, loin and head) were evaluated. The live weight values for California, New Zealand, Chinchilla and Black Azteca were 1.801 ± 0.023 , 1.800 ± 0.023 , 1.776 ± 0.025 and 1.598 ± 0.024 g (mean±standard error), respectively. The carcass yield values were for New Zealand $55.40\pm 0.27\%$, Chinchilla $55.21\pm 0.27\%$, Black Aztec $55.04\pm 0.24\%$ and $53.47\pm 0.24\%$ for California. For the quartered specimens, the values by breed were, New Zealand, California, Chinchilla and Black Aztec respectively forelimbs: 315.09 ± 5.04 , 287.45 ± 6.43 , 284.40 ± 6.38 and 284.43 ± 5.39 , hind limbs: 359.09 ± 6.14 , 326.66 ± 6.03 , 314.61 ± 6.92 and 320.66 ± 5.67 . On the loin: 265.00 ± 5.71 , 252.80 ± 5.74 , 239.61 ± 6.12 g and 235.56 ± 4.64 g head weight: 140.72 ± 1.96 , 142.89 ± 2.04 , 129.13 ± 2.17 and 129.05 ± 1.93 g. Further research is needed on the Black Aztec breed, which showed a good carcass index. California breed scored the lowest carcass index data.

DEVELOPMENT OF MOLECULAR TESTS FOR IDENTIFICATION AND STUDY OF GENETIC DIVERSITY OF EIMERIA SPP. IN RABBITS FROM THE SOUTH EAST OF MEXICO STATE

BAUTISTA G.L.*, MARTÍNEZ C.J.†, JIMÉNEZ R.A.*, GARCÍA R.V.*, ROMERO N.C.‡

*Laboratorio de Biotecnología, Diagnóstico Molecular y Genética. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Ctra. Amecameca-Ayapango, km 2.5, Amecameca, CP. 56900, Estado de México, México.

†Laboratorio de Biología Molecular, Centro de Investigación y Estudios Avanzados en Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, Toluca, C.P. 50090, Estado de México, México.

‡Clínica Veterinaria de Animales de Compañía. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Ctra. Amecameca-Ayapango, km 2.5, AMECAMECA, CP. 56900, Estado de México, México.

lin_bag@yahoo.com.mx

Poverty is one of the great challenges to be solved by the State, as 47% of the Mexican population is in some degree of food poverty, capacity or equity, and SEDESOL (2008) mentions that more than 86% of the poor are in rural areas. Rabbit breeding as a livestock activity has been shown to be important in the last four decades, and is now established as an alternative to solve food and poverty problems in rural and suburban society. Rabbit rearing is noted for its easy productive and reproductive management, the quality of derivative products and the beneficial characteristics of rabbit meat. However, there are significant economic losses in rabbit production due to the presence of infectious agents, causing a great number of diseases. One of the most important, coccidiosis, consists of infections caused by obligate intracellular protozoan parasites belonging to the genus *Eimeria* and considered major causes of significant morbidity and mortality in rabbits. Eimeriosis has 2 presentations; hepatic and intestinal infections caused by 11 species of *Eimeria*, of which only *E. stiedae* causes liver eimeriosis, leading to stunted growth and weight loss. The other species cause the intestinal manifestation of eimeriosis, leading to mortality even with a low level of infestation. The identification of each *Eimeria* species is characterised by morphological and micrometric features, although the implementation of more sensitive diagnostic methods that enable timely and accurate identification of the agent is necessary. To this end, the aim of this study was to identify the *Eimeria* spp. species present in stool samples of rabbits with enteric symptoms in the south east of Mexico State. Sampling was performed in rabbits from one to three months old that had not been treated with coccidiostats, regardless of race, sex or type of unit rabbit production. A total of 72 samples were collected and analysed by microscopy, obtaining 8.66% of samples positive for *Eimeria* spp. The collected samples were analysed by means of chain reaction (PCR) using primers ITSF 5' GGAAGTTGCGTAAATAGA 3', ITS R 5' CTGCGTCTTCATCGAT 3' (Oliveira *et al.*, 2010) that amplify a fragment of 400-600 bp of the ITS1 region of *Eimeria* spp., whereby the percentage increase at 16.6%, the molecular identification of *Eimeria*, identified the species found in positive samples, finding *E. stiedae*, *E. performans*, *E. magna*, *E. coecicola*, *E. flavescens* and *E. exigua*. The results obtained are of great importance, as the literature points to *E. stiedae* as the most pathogenic species affecting rabbits. It is noteworthy that the phylogenetic analysis of the sequences obtained in this study show genetic diversity of *Eimeria* species reported here, as described worldwide.

MOLECULAR IDENTIFICATION AND PHYLOGENETIC ANALYSIS OF *PASTEURELLA* SPP. IN RABBITS FROM THE SOUTH EAST OF MEXICO STATE

BAUTISTA G.L.*, GARCÍA R.V.*, MARTÍNEZ C.J.†, ROMERO N.C.‡, JIMÉNEZ R.A.*, REYNOSO U.E.*, LÓPEZ-AUGADO A.G.*, HUITRON T.G.*

*Laboratorio de Biotecnología, Biología Molecular y Genética. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México. †Laboratorio de Biología Molecular, Centro de Investigación y Estudios Avanzados en Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, C.P. 50090, Estado de México, México. ‡Clínica Veterinaria de Animales de Compañía. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México.

lin_bag@yahoo.com.mx

One factor that affects the efficient development of rabbits in Mexico is the high mortality rate in rabbit farms (SAGARPA, 2012). *Pasteurella multocida* is responsible for the most economically important diseases in animals in both developed and developing countries (Dziva *et al.*, 2008). The aim of this study was to perform molecular and phylogenetic identification of *Pasteurella multocida* in rabbits of all ages that present respiratory symptoms, as well as in apparently healthy individuals housed in the same rabbit production units where respiratory symptoms are presented.

MOLECULAR DIAGNOSTICS OF ROTAVIRUS IN RABBITS IN THE SOUTH-EAST OF MEXICO STATE

REYNOSO U.E.*, GARCÍA R.V.*, MARTÍNEZ C.J.†, ROMERO N.C.‡, LÓPEZ-AGUADO A.G.*, BAUTISTA G.L.*

*Laboratorio de Biotecnología, Diagnóstico Molecular y Genética. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México. †Laboratorio de Biología Molecular, Centro de Investigación y Estudios Avanzados en Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, C.P. 50090, Estado de México, México. ‡Clínica Veterinaria de Animales de Compañía. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México.

Mvz.manolo77@gmail.com; lin_bag@yahoo.com.mx

In our country, Mexico State is the major rabbit production entity, with 45000 head of stock and production figures around 2340 tons. Enteric diseases play an important role in rabbit production, causing severe economic losses due to mortality, growth depression and worsening of conversion index. Rotaviruses (RV) are members of the *Reoviridae*

family, non-enveloped viruses with a segmented double-stranded RNA (dsRNA) genome, considered the main cause of acute viral gastroenteritis in different animals including rabbits. This agent is also a zoonotic disease. Among all enteric pathogens in humans, Rotavirus is the leading cause of severe acute gastroenteritis in infants and young children worldwide, affecting 95% of children under 5 yr of age and causing 453 000 infant deaths annually. Group A rotavirus, lapine strain (infecting rabbits), has been isolated by researchers in Europe, Japan and the United States, although there are no studies molecularly identifying lapine rotavirus in our country. For this reason, in this study we developed a molecular diagnosis of Rotavirus using Reverse Polymerase Chain Reaction (RT-PCR), which will allow genotyping of strains that infect rabbit meat producers in the south-east of the State of Mexico. The molecular diagnosis was carried out with the VP6 primers (VP6-F [sense] 5' GACGGVGCRACTACATGGT 3' and VP6-R [antisense] 5' GTCCAATTCATNCCTGGTGG 3') reported by Gómara *et al.* (2002). Viral RNA was extracted using the GeneJET Viral DNA and Thermo Scientific RNA Purification kit, according to the manufacturers' instructions. The RotaTaq vaccine was used as a positive control. Standardisation was carried out, achieving the amplification of a 379 pb region of VP6. The results show the presence of rotavirus in rabbits in the study region. We provide the first data on rotavirus in rabbits in Mexico. Data collected may contribute to avoiding economic loss, while development of a vaccine and will help resolve public health problems.

DIFFERENTIAL GENE EXPRESSION PROFILES OF EMBRYOS IN REX RABBITS WITH DIFFERENT WOOL DENSITY

LI B., ZHU Y., WANG C.Y., WANG X.P., LI F.C.

College of Animal Science and Technology, Shandong Agricultural University. No. 61, Daizong Street, Tai'AN, Shandong Province, 271018, China
chlif@sdau.edu.cn

Rex Rabbit is one of the world's major rabbit fur breeds and hair density is an important factor affecting the quality of their hides. However, research into hair density in the molecular area has rarely been reported. In order to screen differentially expressed genes in embryonic Rex rabbits with different wool density, the Agilent Rabbit Gene Expression Microarray was used to determine the differentially expressed genes. The expression patterns of selected differentially expressed genes were further identified by quantitative real-time PCR (Q-RT-PCR). A total of 1342 differentially expressed genes associated with Rex rabbit wool density were screened out. These genes included 950 upregulated genes and 392 downregulated

genes. Gene ontology (GO) analysis revealed that most of the differentially expressed genes were distributed in the cell and plasma membranes and belonged to the receptors and DNA binding molecules. KEGG pathway analysis revealed that these differential genes were mainly involved in the typical signalling pathways of Sonic Hedgehog (Shh), etc. The results suggest that the gene expression profile of embryonic Rex rabbits with different wool density is different, and some important genes identified may be useful in further studies on wool density molecular markers of Rex rabbits.

ANALYSIS OF SEASON EFFECTS ON WEIGHT GAIN ON MEAT RABBITS

CORDIVIOLA C.A.* , CALONGE F.S.* , TRIGO M.S.* , ARIAS R.O.* , MARTINO P.† , ANTONINI A.G.†

*Introducción a la Producción Animal, Facultad de Ciencias Agrarias y Forestales, Universidad Nacional de La Plata. Calle 60 y 119, LA PLATA, Argentina. †Instituto de Genética Veterinaria. Facultad de Veterinaria. Universidad Nacional de La Plata. Argentina. Calle 60 y 119, LA PLATA, Argentina. ‡Comisión de Investigaciones Científicas. Calle 60 y 119. LA PLATA, Argentina.
cordiviola@argentina.com

Rabbit production is highly influenced by weather conditions (Cabrero Saenz *et al.*, 1982). Production parameters such as milk production and reproductive efficiency are often affected. (Baltazar, 2012; Cordiviola *et al.*, 2014). The aim of this research was to assess the impact of weather factors on meat rabbit performance. In this study, the parameters of weight and age in days for slaughter were analysed, including measures of average, maximum and minimum temperature and relative humidity. Data was analysed by statistical analysis (ANOVA) and simple regression of temperatures. Comparisons of correlation coefficient of temperatures were also carried out. Moreover, months were separated by average temperature according to rabbit comfort temperature as hyperthermic (>20°C), isothermal (18-20°C) and hypothermic (<20°C) and analysed by ANOVA. This month separation was determined according to Cervera *et al.*, 1998. Data was recorded at the experimental rabbit breeding barn of the Facultad de Ciencias Agrarias y Forestales of Universidad Nacional de La Plata, recording 920 newborn and slaughtered rabbits in one year, with a mix of breeding between Californian and New Zealand crosses. Climate data was provided by the weather station situated in the "Julio Hirschhorn" experimental field of Facultad de Ciencias Agrarias y Forestales of Universidad Nacional de La Plata, located 10 km away from the experimental barn. Results indicated that average temperature was more influential than minimum and maximum temperature, while relative humidity had no influence. Besides, isothermal and hypothermic months showed no significant

differences. Nonetheless, hyperthermic months revealed significant differences. This study proved that rabbit production is more influenced by weather factors like heat rather than frosty environments. Likewise, relative humidity was not influential due to averaged values and the absence of epidermal diseases. These results are in accordance with local weather conditions in this region (Lat. 34°54'31.09"S; Long. 57°55'56.37"W).

IDENTIFICATION AND CULTURE OF *EIMERIA* SPP. FROM RABBITS WITH GASTROENTERIC SIGNS IN SOUTH-EAST OF MEXICO STATE.

TREJO H.G.*, BAUTISTA G.L.*, MARTÍNEZ C.J.†, GARCÍA R.V.*, ROMERO N.C.‡

*Laboratorio de Biotecnología, Diagnóstico Molecular y Genética. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México. †Laboratorio de Biología Molecular, Centro de Investigación y Estudios Avanzados en Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, C.P. 50090, Estado de México, México. ‡Clínica Veterinaria de Animales de Compañía. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México.

Mvz.huitron@gmail.com; lin_bag@yahoo.com.mx

Rabbit production has become more important as a livestock industry in our country in recent years, mainly due to the ease of handling of the species and the relatively short time for recovery of investments, which has encouraged a large number of small and medium rural producers to dabble in exploitation of this species. Mexico State is the main rabbit production area in our country, so the identification of pathogens that affect this activity becomes a priority. Eimeriosis is a parasitic disease caused by protozoa of the genus *Eimeria*, and depending on the species this parasite may be located in the intestine or liver of the hosts. The species of most pathogenic intestinal location include, in order of predominance, *E. perforans*, *E. magna*, *E. intestinalis*, *E. media*, *E. piriformis*, *E. irresidua*, *E. flavescens*, *E. exigua* and *E. neoleporis*, while the pathogenic species found in the liver is *E. stiedae*, which may be associated or not with intestinal forms depending on the pathogenicity, infective dose and age of the host. Eimeriosis is one of the most important parasitic diseases in farm rabbits and can cause significant economic losses and generate growth retardation, worsening of transformation rates and even increased mortality. The aim of this study is to identify the presence of *Eimeria* spp. in rabbits that present enteric

signs in the south east of Mexico State. To this end, the use of vitro culture is necessary to isolate the species present in the region. This way, we will be able to study the pathogenicity of each variant found and the molecular characterisation of the same.

IDENTIFICATION OF ASTROVIRUS IN RABBITS BY MOLECULAR DIAGNOSIS, IN THE SOUTH-EAST OF MEXICO STATE

LÓPEZ AGUADO A.G.*, MARTÍNEZ C.J.†, GARCÍA R.V.*, ROMERO Nc, REYNOSO U.E.*, BAUTISTA G.L.*

*Laboratorio de Biotecnología, Diagnóstico Molecular y Genética. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México. †Laboratorio de Biología Molecular, Centro de Investigación y Estudios Avanzados en Salud Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, C.P. 50090, Estado de México, México. ‡Clínica Veterinaria de Animales de Compañía. Universidad Autónoma del Estado de México, Centro Universitario UAEM Amecameca. Licenciatura en Medicina Veterinaria y Zootecnia. Carretera Amecameca-Ayapango km 2.5, AMECAMECA, CP. 56900, Estado de México, México.

gab-fk@hotmail.com, lin_bag@yahoo.com.mx

The astroviruses form a family of small RNA viruses measuring from 28 to 30 nm, which infect a variety of mammalian and avian hosts. First identified in human stool samples in 1975, these viruses were named after their star-shaped appearance in some electron micrographs and are known as causal agents of severe gastroenteritis in mammals and fowl. In rabbits they cause problems including enteritis, enterocolitis, lethargy, inflammation and diarrhoea followed by death of the animal, also related with a heavy intestinal coccidial presence of *Eimeria* spp., specifically of mucoid enteropathy with cecal impaction. Again the environment may alter the physiology, favouring the presence of this virus, leading to reduced production and important economic losses. This virus is considered zoonotic, although the ecological interrelation between human astrovirus and other viruses of other species has not been well defined. Rabbit production is a nationwide activity, but in Mexico State there are no reports of the presence of this virus, or any economic losses caused. The aim of the present study is to implement the reverse transcription - polymerase chain reaction (RT-PCR) technique for diagnosis of astroviruses in rabbits. The Viral RNA will be extracted using the Thermo Scientific GeneJET viral DNA and RNA Purification Kit following the manufacturer's instructions. The samples collected are used for an initial screening with a broadly reactive primer pair, targeted on the ORF1b region of AstV (Lavazza, *et al.*, 2009). The initial screening will be in a rabbit farm presenting

animals with symptoms of enteritis, enterocolitis, lethargy, inflammation and diarrhoea. The results of this work can be used in identification and phylogeny to develop prevention programmes including diagnostics, with the aim of reducing the loss of animals from this pathology and significantly cutting economic losses.

ETHOLOGY, HOUSING & WELFARE

INFLUENCE OF ENVIRONMENTAL ENRICHMENT, COMPOSITION OF THE SOCIAL GROUP AND AGE ON MAINTENANCE AND COMFORT BEHAVIOURS IN GROWING RABBITS

MOURA A.S.A.M.T., BOZICOVICH T.F.M., FERNANDES S., DE SIQUEIRA E.R.

Departamento de Produção Animal, Faculdade de Medicina Veterinária e Zootecnia, UNESP, CEP: 18618-970, BOTUCATU, SP, Brazil, (Financial support: FAPESP and CNPq)

anamoura@fmvz.unesp.br

The objective was to investigate whether environmental enrichment and the social group composition would affect the frequency of maintenance and comfort behaviours in growing rabbits. The experiment was initiated at weaning at 5 wk and finished at 11 wk of age, involving 144 rabbits from the Botucatu genetic group, 72 males and 72 females. The animals were assigned to a completely randomised design, in a 2×3 factorial arrangement (with or without cage enrichment and 3 compositions of social groups – males, females, or mixed genders) with repeated measures (weeks) and 4 replicates. Stocking density was 6 rabbits/cage (0.48 m²). Two eucalyptus sticks were hung from the cage ceiling in enriched cages. Six cameras were used for image recording for 24 h, once a week, on weeks 7, 10 and 11. The behavioural activities were “feeding” (eating or drinking), “resting” (sitting, lying or sleeping) and “grooming” (licking, scratching or nibbling of the body). Cages were scanned once every 20 min to record these behaviours. The numbers of occurrences per day were summed up on a cage basis. A social group×age interaction effect was found on feeding: in week 7, female groups showed higher frequency of feeding behaviour than male and mixed groups; this difference disappeared in weeks 10 and 11. An enrichment x age interaction effect was found on grooming: in weeks 10 and 11 rabbits in enriched cages showed lower frequency of grooming, but this difference was absent in week 7. As age progressed, feeding decreased and grooming increased. Resting was more frequent in week 10 than in weeks 7 and 11. Environmental enrichment and composition of the social group changed maintenance and comfort behaviours in growing rabbits.

INTELLIGENT CAGE FOR GROWING OR ADULT MALE PET RABBITS

MACHADO L.C.*, RIBEIRO B.P.V.B.†, GERALDO A.*, HEKER M.M.‡, NORONHA C.M.S.*, PIMENTEL F.E.†, SILVA I.M.†

*Professor Minas Gerais Federal Institute - Bambuí Campus – Brazil. †Student of Animal Science at Minas Gerais Federal Institute - Bambuí Campus – Brazil. ‡Ph.D. Student from São Paulo State University (UNESP), Aracatuba Campus - Brazil
luiz.machado@ifmg.edu.br

Nowadays animal welfare is becoming a major concern for society. Pet rabbit breeding is expanding in Brazil and no type of enclosed environment that provides comfort and welfare for these animals is available. If loose, rabbits can dig holes, chew on furniture, eat plants and urinate/defecate in inappropriate places. This paper describes the development of an enclosed environment (intelligent cage) for growing or adult male rabbits and presents results from a study of their behaviour. The cage was built with dimensions 0.90×0.78 m (0.70 m²). For environmental enrichment, a PVC pipe, a platform, a wood swing, a hanging plate, some dangling chains and a place for treats were added. The cage was set 1.20 m above the ground, with a bottom tray easily sliding out to allow cleaning and scrubbing when needed. A camera with infrared light was used to monitor the animals for 24 h for 50 min periods for 7 d so that all 24 h were registered. A Fuzzy Lop male was observed every 30 s, with a total of 2400 records. To observe the animal's preference in the cage, 8 separate locations were named and 18 different types of behaviour were considered. For statistical analysis, each 6-h shift (00:00-06:00, 06:00-12:00, 12:00-18:00 and 18:00-24:00) was considered as treatment and each week day consisted of a replicate. A high frequency of playful and exploratory behaviour was observed in addition to interaction with environmental enrichment. The most frequent behaviour was lying down (41.47%) and the most popular places in the cage were: the sides of the cage (61.70%) and treat region (12.58%). Considering the shifts, a higher incidence of licking/scratching behaviour was observed in the morning (06:00-12:00). The animals moved around, more frequently, during the morning (00:00-06:00) and evening (18:00-24:00) and gnawed the cage bars more frequently in the morning (00:00-06:00), probably due to the expected human presence. Studies with intelligent cages should be improved to provide greater comfort and convenience for the animals.

USE OF DIFFERENT MATERIALS FOR NEST BEDDING OF PREGNANT DOES

OLIVEIRA M.C.*, MESQUITA S.A.*, SILVA T.R.*, LIMA S.C.O.*¹, MACHADO L.A.*, OLIVEIRA H.C.*, OLIVEIRA J.C.†, OLIVEIRA E.S.*

*Faculty of Veterinary Medicine, University of Rio Verde, RIO VERDE, GO, 75.901-910. Brazil. †Federal Center of Technological Education of Minas Gerais, DIVINÓPOLIS, MG, 35503-822. Brazil. ‡Scientific Initiation Fellow from CNPq. mcorv@ig.com.br

This study was carried out to evaluate the nesting characteristics of pregnant does with different bedding material and its effect on the litter size and weight at birth and weaning and on the nest material used by the doe. Thirty does were used in a randomised block design with 3 treatments and 10 replicates each. The treatments consisted of the nest bedding with wood shavings (280 g), Tifton hay (220 g) and chopped newspaper (200 g). The nest state was evaluated in relation to the material mixture level with fur, to fur presence and to the preservation of the original material put in the nest, beyond the litter size and weight at birth and weaning. There was no effect ($P>0.05$) of the bedding material type on the litter size and weight at birth and weaning and on the mixture level with fur, the amount of fur in the nest and on the preservation of the original material placed in the nest. It was concluded that Tifton hay and chopped newspaper may be used as nest bedding for pregnant does, replacing the wood shavings without impairing litter performance.

INTELLIGENT CAGE WITH NESTING CHAMBERS FOR DOES

MACHADO L.C.*¹, RIBEIRO B.P.V.B.[†], GERALDO A.*², HEKER M.M.[‡], NORONHA C.M.S.*³, PIMENTEL F.E.[†], SILVA I.M.[†]

¹Professor Minas Gerais Federal Institute - Bambuí Campus – Brazil. ²Student of Animal Science at Minas Gerais Federal Institute - Bambuí Campus – Brazil. ³Ph.D. Student from São Paulo State University (UNESP), Aracatuba Campus - Brazil luiz.machado@ifmg.edu.br

In Brazil, mini rabbit breeding is expanding. It is important to investigate their welfare in cages. The cages available in the market are small, without attraction, which leads the animals to laziness. If loose they can make holes in the ground. Moreover, in Brazil, there are no nests that simulate the natural conditions. This work describes the development of an enriched environment (intelligent cage) for rabbits, identifies behaviours and verifies the possibility of a nesting chamber. The cage was built using materials easily found in the market, with dimensions 1.20×0.80 m (0.96 m²). For environmental enrichment, a PVC pipe, a platform, a wood swing, a hanging plate, some dangling chains and a place for treats were added. Before the doe's due date, a nesting chamber was included. An infrared light camera was used to monitor the animals for 24 h for 7 d, during 50 min periods, so that all 24 h were registered. A Mini Lionhead female was observed every 30 s, with a total of 2400 records. To observe the

animal's preference in the cage, 8 separate locations were named and 16 different types of behaviour were considered. For statistical analysis, each 6-h shift (00:00-06:00, 06:00-12:00, 12:00-18:00 and 18:00-24:00) was considered as a treatment and each weekday consisted of a replicate. The use of the nesting chamber was monitored for 4 consecutive births. A high frequency of exploratory behaviour was observed in addition to interaction with environmental enrichment. The animal remained lying almost half of the time and presented higher incidence of licking/scratching at the 06:00-12:00 period. The animal remained in the sitting position more frequently in the morning (06:00-12:00) and evening (18:00-24:00). Regarding the use of the nesting chamber, in the 1st parity, although the doe prepared the nest, the parturition occurred in the cage, a normal behaviour in young does (1st partum). In the 2nd, 3rd and 4th parities, the doe prepared the nest and gave birth inside it. New experiments involving intelligent cages should be performed to improve welfare technology for these animals.

EFFECT OF DIFFERENT NEST BEDDING MATERIALS FOR PREGNANT DOES ON THE NEST BUILDING PATTERN

OLIVEIRA M.C.*¹, LIMA S.C.O.*², SILVA T.R.*³, SILVA J.A.*⁴, MESQUITA S.A.*⁵, OLIVEIRA H.C.*⁶, OLIVEIRA J.C.[†], OLIVEIRA E.S.*⁷

¹Faculty of Veterinary Medicine, University of Rio Verde, RIO VERDE, GO, 75.901-910. Brazil. ²Federal Center of Technological Education of Minas Gerais, DIVINÓPOLIS, MG, 35503-822. Brazil. ³Scientific Initiation Fellow from CNPq. Brazil.

mcorv@ig.com.br

This research was carried out to evaluate the effect of different bedding nest materials for pregnant does on the nest building pattern. Thirty does were used in a randomised block design with 3 treatments and 10 replicates each. Treatments consisted of the nest lined with wood shavings (280 g), Tifton hay (220 g) or chopped newspaper (200 g). The nests were placed inside the cage 3 d before the birth and taken out at 20 d after birth. Evaluation of the nest status consisted of qualitative analysis of the mixture level of the material with fur, the presence of fur in the nest and the preservation of the original material put inside initially. These observations finished at the birth day. Data were submitted to the Spearman correlation, to which was applied the t test at 5% of probability. Correlations between fur presence, mixture level of fur and material, and amount of material present in the nest at the birth were not significant ($P>0.05$). As there was no correlation among the used materials and the fur amount, mixture and material amount in the nest, it is possible to infer that there was no difference for the rabbit doe in relation to the

comfort obtained with the materials used. There was no significant correlation ($P>0.05$) between material type and total born number, but there was a correlation between fur presence in the nest and mixture level ($P<0.001$) and between mixture level and amount of material in the nest at birth ($P<0.05$), which means the higher the amount of fur in the nest, the more mixture level with the material placed previously and, in the nests where the rabbit does took out the highest amount of material, the doe also placed a higher amount of fur, possibly to maintain comfort in the nest. It was concluded that Tifton hay and chopped newspaper may be used as nest bedding for pregnant does, replacing the wood shavings with no negative effect on the nest building pattern.

EVALUATION OF ANXIETY OF GROWING RABBITS IN ENRICHED CAGES

BOZICOVICH T.F.M., GELIER P.A., FERNANDES S., SIQUEIRA E.R., MOURA A.S.A.M.T.

Departamento de Produção Animal, Faculdade de Medicina Veterinária e Zootecnia, UNESP, CEP: 18618-970, BOTUCATU, SP, Brasil, (Financial support: FAPESP and CNPq).

pitszoo@fmvz.unesp.br

The level of adaptation of growing rabbits to housing and management conditions may be evaluated through their behavioural response to reactivity tests, in which their reaction to and fear of a new environment are assessed. This study aimed to evaluate the anxiety of rabbits that had access (or not) to an enriched environment. A total of 32 male rabbits from the Botucatu genetic group were involved from weaning at 35 d up to 79 d of age. The animals were assigned to a completely randomised design with 2 treatments (with or without access to environmental enrichment) and allocated to 8 wire cages, 4 animals/cage. Two eucalyptus sticks (15×3×3 cm) hanging from the cage ceiling were used as enrichments. Anxiety-related (freezing) and locomotion behaviours were evaluated using the elevated plus-maze, in which the animals were allowed to explore 2 elevated open and 2 elevated closed arms. Two observations of 5 min each, at 49 and 79 d of age, were carried out. At the beginning of the test, each animal was placed in the centre of the apparatus. The latency time to enter the open and closed arms, the number of entries and the time spent in open and closed arms, the frequency of head dipping and of standing up were registered. Growth performance of animals was recorded from 35 to 77 d of age. On day 49, the latency to the first open arm entry was shorter in animals from enriched cages. On day 79, the animals from non-enriched cages stayed longer in the open arms and showed higher frequency of head dipping than the animals in enriched cages. The animals in enriched cages, on the other hand, stayed longer in

the closed arms. Feed conversion was poorer in enriched than in non-enriched cages (2.91±0.06 vs. 2.64±0.06, $P=0.03$), while other performance traits (final weight, average daily gain and feed consumption) did not differ between groups. The environmental enrichment had a positive effect on the behaviour of young rabbits by reducing their anxiety.

PERFORMANCE OF RABBITS BORN IN NESTS LINED WITH DIFFERENT MATERIALS

OLIVEIRA M.C.*, SILVA T.R.*, LIMA S.C.O.*¹, SILVA J.A.*, MESQUITA S.A.*, MACHADO L.A.*, OLIVEIRA J.C.[†], OLIVEIRA E.S.*

*Faculty of Veterinary Medicine, University of Rio Verde, Rio Verde, GO, 75.901-910. Brazil. [†]Federal Center of Technological Education of Minas Gerais, DIVINÓPOLIS, MG, 35503-822. Brazil. ¹Scientific Initiation Fellow from CNPq. Brazil.

mcorv@ig.com.br

This study was carried out to evaluate the performance of rabbits reared in nests lined with different materials from birth to weaning. Thirty rabbit does were used in a randomised block design, with 3 treatments and 10 replicates each. The treatments consisted of the nest lining with wood shaving (280 g), Tifton hay (220 g) and chopped newspaper (200 g). Body weight, daily weight gain and survival rate were weekly evaluated from the birth to the weaning. There was no effect ($P>0.05$) of the material type used as nest bedding on the body weight, daily weight gain and survival rate. This suggests that both Tifton hay and chopped newspaper may be used to replace the wood shavings as nest bedding, by offering similar comfort to the kits, from birth up to their weaning. The survival rate was not affected ($P>0.05$) by the treatments, but it was observed that mortality occurred until the 3rd wk of life in the nests lined with wood shavings and Tifton hay, and until the 2nd wk of life in the nests lined with chopped newspaper, possibly because the chopped newspaper provided a more comfortable and warmer environment for the kits. It was concluded that Tifton hay and chopped newspaper may be used, replacing the wood shaving with no negative effect on litter performance.

REPRODUCTION

CRYOPRESERVATION OF ORNAMENTAL RABBIT SPERM (LIONHEAD)

GONZÁLEZ S.J.A.[†], JIMÉNEZ S.E.[‡], GONZÁLEZ G.A.N.[#], HERRERA B.J.A.[†], ÁVALOS R.A.[†], RIVERA M.J.G.*

*Universidad Autónoma Metropolitana – Iztapalapa. Department of Biology of Reproduction. MEXICO, D.F.

[†]Universidad Autónoma Metropolitana – Xochimilco. Department of Agricultural and Animal Production. MEXICO, D. F. [‡]Student of the Bachelor of Veterinary Medicine, UAM-X. [§]Student of Bachelor of Animal Production, UAM-I.

rmjg@xanum.uam.mx

Ornamental rabbit production has increased in the last 10 yr, due to the demand for companion pets for their different aspects and phenotypic characteristics. However, there have been no studies on reproductive management in this type of production, particularly in the semen quality of bucks, used much less in the cryopreservation of genetic material. Therefore, the objective of this study was to determine the seminal indicators in fresh and thawed Lionhead rabbit sperm. Ten ejaculates were collected by artificial vagina from 3 Lionhead bucks and the samples obtained were evaluated for gross motility, progressive motility and live sperm then cryopreserved using dimethyl sulphoxide 6%; after thawing, gross motility and live spermatozoa were evaluated. The results obtained in fresh for gross motility were 4, progressive motility 91.15 ± 6.18 (means \pm standard error) and live spermatozoa 94.55 ± 5.10 . After thawing, we obtained a progressive mobility of 44.23 ± 6.41 and live sperm 49.38 ± 6.64 . We conclude that Lionhead rabbit sperm can be cryopreserved, obtaining acceptable results after thawing.

MORPHOMETRIC CHARACTERISATION SPERM IN THREE LINES OF ORNAMENTAL RABBITS

RIVERA M.J.G.*[‡], LÓPEZ R.O.[‡], RAZO C.V.[‡], MARTÍNEZ P.E.S.[‡], GONZÁLEZ G.A.N.[§], HERRERA B.J.A.[†], ÁVALOS R.A.[†], GONZÁLEZ S.J.A.[†]

*Universidad Autónoma Metropolitana – Iztapalapa. Department of Biology of Reproduction. MEXICO, D. F.

[†]Universidad Autónoma Metropolitana – Xochimilco. Department of Agricultural and Animal Production. MEXICO, D. F. [‡]Student of the Bachelor of Veterinary Medicine, UAM-X. [§]Student of Bachelor of Animal Production, UAM-I.

rmjg@xanum.uam.mx

Production of ornamental rabbits has undergone a boom in the last 10 yr due to the demand for these pets for the phenotypic characteristics that make them attractive. However, there are no studies available where the morphometric features of their sperm are evaluated. Therefore, the objective of this study was to evaluate the sperm morphometry by evaluating 3 ornamental rabbit lines (Dutch Dwarf, Mini Rex and Lop Lionhead). Five ejaculates were obtained from each stud, using one artificial vagina, for morphometry evaluation by digital microscope; OPTISUM MIC990FT DC-M900, software Scop-Photo and observed with a 100 \times objective. The results in terms of total length were: Dwarf Dutch 30.56 ± 0.025 μ m (mean \pm standard error), Mini rex 30.50 ± 0.22 μ m and Lop Lionhead 30.22 ± 0.39 μ m. We

conclude that there is a morphometric difference between sperm from the 3 ornamental rabbit lines studied.

WEIGHT GAIN IN REPRODUCTIVE RABBITS THROUGH THE APPLICATION OF A SELECTION SYSTEM AND BREEDER IN A CLOSED POPULATION

MELÉNDEZ T.C.

Universidad Pedagógica Experimental Libertador, Instituto Pedagógico de Barquisimeto "Luis Beltrán Prieto Figueroa". Avenida José María Vargas con Avenida Las Palmas, BARQUISIMETO, Lara state. Venezuela.

carloscant@hotmail.com

To determine if there are differences in the weights of reproductive male rabbits after 90 d of age, following application of a Selection System in a closed population. Materials: Reproductive male crossbred rabbits. Method: Weight calculated at the 90th d of birth of the reproductive males. Results: The weight gain of the animals in study was of 246 g. Conclusion: The selection system applied was successful.

EFFECT OF DIFFERENT GnRH ANALOGUE TREATMENTS ON THE PERFORMANCE OF LACTATING RABBITS

EIBEN C.S.*[‡], SÁNDOR M.[†], SÁNDOR F.[†], TOKAI A.[†], KUSTOS K.[‡]

*Centre for Farm Animal Gene Conservation (HáGK), Isaszegi út 200, GÖDÖLLŐ, H-2100, Hungary. [†]S&K-Lap Ltd., Császár u. 135., KARTAL, H-2173, Hungary. [‡]Szent István University, Péter K. u. 1., GÖDÖLLŐ, H-2100, Hungary.

eiben@katki.hu, zikaszov@gmail.hu, kustos.karoly@mkk.szie.hu

Reproductive traits of 210 rabbits inseminated on post-partum day 11 and induced to ovulate by intramuscular 0.84 μ g or 1.26 μ g buserelin acetate (Receptal[®] or Suprefact[®]) or 20 μ g gonadorelin (Fertagyl[®]) or by intravaginal 25 μ g GnRH analogue [des-Gly10, D-Ala6]-LHRH (luteinizing hormone-releasing hormone) ethylamide in 0.5 mL semen extender (MRAbit[®]) were studied according to reproductive status under farm practice (only light stimulation). The data were evaluated by the chi-squared test or by ANOVA using the Statgraphics 6.0 (1992) statistical software. Pregnancy and kindling rates and the number of live born kits per litter were not affected by the GnRH treatments, but differed ($P < 0.05$) in parity and receptivity (94%, 89%, 11.7 in multiparous receptive vs. 77%, 69%, 9.42 in primiparous non-receptive, or 10.2 kits in multiparous non-receptive does, respectively). Global productivity (number of liveborn kits per 100 inseminations) with Receptal[®] in primiparous receptive or non-receptive or in multiparous receptive or non-receptive does were 930, 450, 1020, 787, with

Suprefact® 1064, 670, 1209, 895, with Fertagyl® 489, 763, 1003, 832 and with MRAbit® 715, 600, 1010, 850, respectively. With the studied i.m. and i.vag. GnRH analogue treatments, the lactating does had good and similar performance under the farm practice of light stimulation with no equine chorionic gonadotropin (eCG) use before insemination. Reproduction was influenced by doe physiological status. Multiparous receptive does had higher productivity.

REPRODUCTIVE MANAGEMENT OF RABBIT BACKYARD PRODUCTION IN THE AREA OF VOLCANOES IN THE STATE OF MEXICO

RIVERA M.J.*, NICOLAS G.A.*, HERRERA B.J.†, HERNÁNDEZ R.M.*, ALMARAZ A.R.*, GONZÁLEZ S.J.*

*Universidad Autónoma Metropolitana Unidad Iztapalapa. Rafael Atlixco No. 186, Col. Vicentina, Delegación Iztapalapa, C.P. 09340, D.F. México. Departamento de Biología de la Reproducción. †Universidad Autónoma Metropolitana Unidad Xochimilco. Calzada del Hueso 1100, Col. Villa Quietud, Delegación Coyoacán, C.P. 04960, D.F. México. Departamento de Producción Agrícola y Animal.

rmjg@xanum.uam.mx

Backyard rabbit production is an activity in which easy keeping and a relatively small space can provide protein for all the family members. To ensure that production takes place, technical aspects such as food, health and especially reproduction issues must be taken into account. The following management study shows how small-scale breeders performed on their farms in the productive and reproductive aspects. The study was conducted in 10 municipalities in the volcanic field south-east of the Mexican Valley. 55 interviews were carried out with small producers, using a structured survey. A total of 2910 doe rabbits were located in the area. The rabbit breeds were New Zealand, Hybrid, California and Creole; 28.5, 27, 22.6 and 21.8% were reported, respectively. Almost all use external studs and most utilised them 4 times per month (41.8%). The annual number of births varies according to the intensity with which the doe is handled, but this data varies from 4 and 6 (66.1%) as reported and 7 to 8 births (41.5%). The doe's reproductive life varies from 12 to 24 months; 38.8% cases reported a useful lifespan from 12 to 18 mo in 25.6% cases, and 39.6% cases for 24 mo. 90% cases reported giving one services per doe and 4% give two and 6% give 3 services. None reported deformities in their kits. Reproductive management for backyard production in the volcanic area of the state of Mexico courage positive data at weaning as the number of weaned rabbits for the majority of backyard rabbit producers is high. With these data, rabbit production for self-consumption is considered good enough, and may cover part of the nutritional needs of farm families.

Moreover, local restaurants consume most of the rabbit production, which may be considered an important tourist corridor in the volcanoes area.

RESISTANCE OF RABBIT SPERM TO CRYOPRESERVATION WITH DILUENTS ENRICHED WITH *CHENOPODIUM AMBROSIODES*

GUADARRAMA V. II, VELÁZQUEZ-CASTAÑEDA S., GUTIÉRREZ-DE HONOR A., CANO-TORRES R., PESCADOR-SALAS N., FELIPE-PÉREZ Y.E.

Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México, Campus El Cerrillo, Toluca, Estado de México. C.P. 50200. Sponsorship PROMEP 103.5/13/6535, Project 653511, FEPYPTC2013, Clave FE09/2013.

yazminyefp@yahoo.com

The great diversity of cryopreservation diluents for semen of different animal species includes different agents that act as cryoprotectors, antibiotics and nutrients which may be used as fuel to give the sperm energy. The latest research has been attempting to avoid damage by including different antioxidants. Many studies have included vegetable extracts from species, with good results. Therefore, the aim of this study was to evaluate the effect of the addition of 10% aqueous solution of *Chenopodium ambrosioides* to rabbit sperm diluents on the sperm viability and plasma membrane response, before and after undergoing cryopreservation. Semen samples were obtained from 3 sexually active New Zealand males using an artificial vagina, semen samples were pooled and routine evaluation was performed in fresh samples as well as after freezing-thawing. Viability was evaluated by using eosin-nigrosin staining; plasma membrane response was evaluated by HOST, at 0, 30 and 60 min in fresh and frozen-thawed samples. Paired T-student test was applied to analyse results. Although no statistical differences were observed between diluents with or without the addition of *Chenopodium ambrosioides* extract ($P>0.05$), there was a tendency to obtain higher viability and HOST positive percentages on the samples enriched with vegetable extracts. In conclusion, the addition of *Chenopodium ambrosioides* extract should be further studied, in order to find the best concentration to induce a positive antioxidant effect on semen rabbit diluents for cryopreservation.

DESCRIPTION OF THE RABBIT (*ORYCTOLAGUS CUNICULUS*) EPIDIDYMIS AND TESTICLES: A HISTOLOGICAL VIEW

ZAMORA E.J.L.*, FELIPE-PÉREZ Y.E.†, VELÁZQUEZ-CASTAÑEDA S.†, VALLADARES C.B.*, FAJARDO M.R.C.*, QUEZADA-BARRERA K.C.H.*, CANO T.R.†, PÉREZ S.L.*, DÍAZ G.B.A.*

*Centro de Investigación y Estudios Avanzados en Salud Animal. †Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México. El Cerrillo Piedras Blancas, CP 50200, Toluca, México, México.

zamoraespinosa@hotmail.com

Rabbit is an attractive species for gonad studies, due to the early development, compared to bigger mammals, as well as the fact that it is the only mammalian species that has the ability of descending or maintaining testicles within the abdominal cavity or in the scrotum. The aim of the present study was to provide a histological description of the rabbit testes and epididymis, which may be useful in male gonadal studies to compare healthy tissues from damaged ones. A total of 30 testicles from slaughtered rabbits ranging from 12 to 18 mo of age were obtained and processed for histopathological studies. Tissue sections of testes, including the epididymis, underwent fixation, dehydration and paraffin blocking, then were finely sliced and stained by haematoxylin and eosin. Testicle evaluation of the stained slides was performed in a light microscope. Pictures of the testicle regions were taken under a Nikon microscope (iX70) adapted to a photo-camera, images were taken using the NisElements software. Microphotographs of various sections of the testicles and epididymis are shown and described within the text.

A CASE OF TISSUE ALTERATIONS FOUND IN PYOMETRA INFECTION IN A DOE

QUEZADA-BARRERA K.C.*, ZAMORA E.J.L.*†, CASTAÑEDA-VELÁZQUEZ S., CANO-TORRES R.†, PESCADOR-SALAS N.†, FELIPE-PÉREZ Y.E. †.

*Centro de Investigación y Estudios Avanzados en Salud Animal. †Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México. El Cerrillo Piedras Blancas, CP 50200, Toluca, Estado de México, México.

zamoraespinosa@hotmail.com, yazminyefp@yahoo.com

Rabbit production in our country has been growing in recent years, along with the health risks that greatly affect profits, as they cause important losses. Among some of the most important health problems on rabbit farms are cases of infertility in does. Various situations such as having a high load of parasites, sub-clinical infections transmitted by the male during copulation, or high and low drastic temperature changes, among others, can be the cause of reproductive problems. Therefore, many does must be removed from the reproduction programmes. In the present study, we report a case of one doe of 18 mo of age, with a good reproductive record; however, it was discarded from the reproductive programme, as it had received many services in the preceding 2 mo. In addition, it presented problems of mastitis, and therefore could not become

pregnant. In the present case, pyometra was detected after euthanising the doe. A histopathological study was conducted on the different regions of the reproductive organ. Evaluation of the reproductive tissue damages was performed using Eosin-Hematoxylin staining. Among some of the findings was the presence of embryos in different phases of destruction by the micro-organisms found in the uterine exudate.

ABDOMINAL ULTRASOUND FOR PREGNANCY DIAGNOSIS IN RABBITS: IS IT AN INTERESTING ALTERNATIVE?

KASSY G.S., UBIRAJARA I.T., SAULO H.W., LUIZ F.C.G.

Pontificia Universidade Católica do Paraná (PUCPR), Rodovia BR 376-km 14. Bairro Costeira, SÃO JOSÉ DOS PINHAIS, Paraná, Brazil.

kgomes13@hotmail.com

An early pregnancy diagnosis is one of the important factors to improve productivity in rabbit production. The most common method is abdominal palpation, but some experience is required to achieve a good success rate. Ultrasonography is used as a tool for pregnancy diagnosis in many animals, including rabbits, but there are no studies on the success rate of pregnancy diagnosis in this species. The aim of this study was to determine the rate of success in diagnosis of pregnancy in rabbit does using real time ultrasound scanning. Twenty sexually mature female rabbits of New Zealand White, California and Chinchilla breeds were randomly allotted to 2 groups (10 rabbits/ group, 1 rabbit/cage). Rabbits in group I were the control group (non-pregnant), and Group II was composed of pregnant does. All females of group II were mated with sexually active bucks and the day of mating was considered as Day 0 of pregnancy. This study was performed at 7-d intervals, from Day 7 after mating until Day 28 of pregnancy. All animals were scanned using a linear probe of 5.0 MHz attached to a Piemedical Medley DP 3200 real time scanner. The abdominal ventral region of each rabbit was shaved and ultrasound gel was used to perform the exam. The ultrasound scans were performed randomly by the same operator, who did not know the group of origin of each female, with the animals kept in lateral recumbent position. At 7 d of pregnancy, the failure rate was 35% because some difficulties in discerning embryonic vesicles from other abdominal structures were found. On 14th, 21st and 28th d the success rates were 100%, as it was possible to visualise the existence of pregnancy easily. Abdominal ultrasonography is an efficient alternative for pregnancy diagnosis in does after the 14th d of pregnancy.

REPRODUCTIVE PARAMETERS OF RABBITS UNDER TROPICAL CONDITIONS: CASE TUXTEPEC, OAXACA

TREJO A.*[‡], RAMÍREZ S.[†], ANTONIO C.M.[†], MEZA V.M.[‡]

*Universidad del Papaloapan, Laboratorio de Reproducción Animal Asistida, Av. Ferrocarril s/n, sin colonia, CP 68400, LOMA BONITA, Oaxaca. México. [†]Universidad del Papaloapan, Laboratorio de Nutrición Animal, Av. Ferrocarril s/n, sin colonia, CP 68400, LOMA BONITA, Oaxaca. México. [‡]Universidad del Papaloapan, Laboratorio de Biotecnología, Circuito Central No. 200, Col. Parque Industrial, CP 68301. TUXTEPEC, Oaxaca. México.

atrejo@unpa.edu.mx

In Mexico, rabbit production is located mainly in the states with an average annual temperature of 20°C. The optimum temperature for normal development of rabbits is between 18 and 20°C. Rabbits are very sensitive to high temperatures, presenting decreased production and reproduction. Rabbit production under tropical conditions emerges as an alternative due to the ability of this species to consume forages. In Mexico, knowledge of rabbit reproduction under tropical conditions is scarce. The aim of this study was to evaluate the reproductive parameters of 2 farms of rabbit producers located in the region of Tuxtepec, Oaxaca. Data of 40 (farm A) and 35 females (farm B) was analysed. Data of 183 births (farm A) and 158 (farm B) recorded over 2 yr was analysed. Data was analysed by two-way analysis of variance (ANOVA) using the SAS program. Means were compared for significant difference ($P < 0.05$). Non-significant difference on fertility rate between both farms was found (71.3 vs. 68.5%), and births during autumn and winter were different ($P < 0.05$) between both farms (38.7 vs. 41.9%). There was no significant difference in litter size between both farms (7.35 vs. 6.60) and significant differences were found ($P < 0.05$) in the sex ratio of kits (56.1 and 54.9% females, respectively). In comparison, results obtained under non-tropical conditions for fertility rate, litter size, births and female kits (sex ratio) are 87.0, 7.60 and 41.7%, respectively. We conclude that under tropical conditions the reproductive parameters of rabbits are altered, such as fertility and female kit ratio.

RABBIT SPERM VIABILITY EVALUATION COMPARING TWO SUPRAVITAL STAINS: EOSIN- NIGROSIN AND TRIPLE- STAINING

SOTO-MARQUEZ V., CASTAÑEDA-VELASQUEZ S., GUADARRAMA-VALDES II, PESCADOR-SALAS N., CANO-TORRES R., FELIPE-PÉREZ Y.E.

Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, Campus El Cerrillo, Toluca, Estado de México.

CP. 50200. * Sponsorship PROMEP 103.5/13/6535, Project 653511, FEPYPTC2013, Clave FE09/2013.

yazminyefp@yahoo.com

Semen evaluation is a very important part of any reproduction programme. Different viability techniques are available for many species; however, not all can be applied to some species, as the phospholipid and protein composition of the sperm plasma membranes differ, allowing us to obtain different patterns to evaluate and distinguish live from dead sperm, as well as the acrosome integrity. Viability is mostly important to evaluate when sperm is preserved for artificial insemination. Therefore, the aim of the present study was to compare rabbit sperm viability using 2 different staining techniques. Semen from 3 reproductive active New Zealand rabbits was obtained and pooled. Immediately after obtaining the fresh semen samples, evaluation of viability was performed before and after dilution in a freezing diluent, just after the cooling period of 1 h at 4°C, by staining the samples with eosin-nigrosin, as well as triple-staining. After the eosin-nigrosin slides were evaluated under an optic microscope (VELAB, VE-V1), incubation with 20%-Giemsa was performed, and the slide was evaluated again under a phase contrast microscope (Olympus, IX70). Counting of 100 sperm-cells was performed twice for each slide. Our results differed between techniques. While evaluating with eosin-nigrosin, viability was higher for all samples ($P < 0.05$), but when evaluation was done with triple staining, viability results decreased drastically (40 to 80%, $P < 0.05$). Therefore, no concordance of the viability results was found between both staining techniques. In the present study, evaluation of viability and acrosomal status using triple staining for rabbit sperm was very difficult, as patterns were not sufficiently clear to differentiate live from dead sperm, or the presence of the acrosomal vesicle. In conclusion, triple staining was not an appropriate technique for evaluation of rabbit semen.

POST-MORTEM MORPHOMETRIC STUDY OF THE TESTICLES IN RABBITS

CASTAÑEDA-VELÁZQUEZ S., CANO-TORRES R., PESCADOR-SALAS N., FELIPE-PÉREZ Y.E.

Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México. Campus "El Cerrillo". Toluca, Estado de México. C.P. 50200. Sponsorship PROMEP 103.5/13/6535, Project 653511, FEPYPTC2013, Clave FE09/2013.

yazminyefp@yahoo.com

In rabbit farms, bucks must often be replaced, and young rabbits must be selected for this purpose. The aim of this study was to look for a correlation between living weight and testicular size of young rabbits. A total of 30 New

Zealand male rabbits of 70 d of age were weighed before being slaughtered and both test testicles were obtained. Using a Bernier scale both testicles were measured, identifying left and right, as well as the different regions of the epididymis. Results obtained were as follows: the living body weight mean: 2184 ± 5.5 g (mean \pm standard error), total size of both testicles: 5.5 ± 0.79 cm. We found a low correlation (0.38, $P < 0.05$) between body weight and testicular development of rabbits at 70 d of age. Therefore, we concluded that in young rabbits, before reaching puberty, there is no marked correlation between testicular development and living body weight. Nevertheless, this parameter could be useful for the selection of males as breeder replacements.

INGUINAL CHANNEL SAC AND TESTICULAR MORPHOMETRIC STUDY IN RABBITS

CASTAÑEDA-VELÁZQUEZ S., CANO-TORRES R., PESCADOR-SALAS N., FELIPE-PÉREZ Y.E.

Departamento de Reproducción Animal, Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México. Campus "El Cerrillo". TOLUCA, Estado de México. C.P. 50200. Sponsorship PROMEP 103.5/13/6535, Project 653511, FEPYPTC2013, Clave FE09/2013.

yazminyefp@yahoo.com

Male rabbits must be selected for breeder replacements in rabbit farms; however, sometimes testicles do not descend into the scrotum at 2 mo of age, due to various genetic factors. The aim of this study was to observe the inguinal channel structures in young rabbits to see how they were arranged in the normal testes descended rabbits. A total of 30 New Zealand male rabbits of 70 d of age were weighed before slaughter and both test testicles were obtained. Using a Vernier scale, both testicles were measured, identifying left and right, as well as the different regions of the epididymis, and the inguinal channel was explored. Observations were as follows: there is a soft tissue that keeps the testicles together inside the abdominal cavity; testicles are enveloped by their various tunics, but the outermost sheet has the ability to surround the testicles and unfold like a sock when they descend into the scrotum. We concluded that in young rabbits, the inguinal channel must be well developed in order to function actively to allow the testicles to descend into the scrotum and return into the abdominal cavity.

THE CHINCHILLA RABBIT, A USEFUL TOOL IN BIOMEDICINE TO STUDY TESTICULAR ALTERATIONS

GUTIÉRREZ-PÉREZ, O.*, ²MONTONGO-SOLÍS P.†, ²VIGUERAS-VILLASEÑOR R.M.†, ²ROJAS-CASTAÑEDA J.C.†, CHÁVEZ-SALDAÑA M.†

*Facultad de Medicina Veterinaria y Zootecnia, CIEIPP/UNAM. JILOTEPEC, Edo. de México, 54240. México. †Laboratorio de Biología de la Reproducción, Instituto Nacional de Pediatría. MÉXICO, D.F. 04530 México.

koala630816@yahoo.com.mx

Experimental animal models in biomedical research continue to be an irreplaceable tool for technological development and the generation of data which will be used once the information is validated. In male children and teenagers, Successful fertility is marked by an adequate gonadal differentiation, establishment of the hypothalamic-hypophyseal-testicular axis, timely proliferation and differentiation of neonatal testicular cells, the descent of testes, and the onset of puberty coupled with proliferation and maturity of testicular cells. The alterations in this process induce reproductive pathologies in the adult. The rabbit (*Oryctolagus cuniculus*) is an ideal model to study these kind of diseases and better than the rodents, as the rabbit has a longer period of testicular development where it is very simple to distinguish both an infantile and/or pubertal stage. On the other hand, buck rabbits are easy to train for semen collection with an artificial vagina, so it can be programmed into protocols to confirm indirectly the effects of different interventions (surgery, drug administration, etc.) on male fertility, and therefore permits longitudinal evaluation of semen. Several breeds of rabbits have been widely used as models for morphological and physiological studies. The most common is the New Zealand rabbit; however, it is known that this breed has a tendency to develop Diabetes mellitus in the long term, which could interfere with the reproductive function. In contrast, there have been no reports of pathological developments in Chinchilla rabbits in the long term that could interfere with their reproductive function. Moreover, the Chinchilla rabbit is smaller and less expensive to maintain than the New Zealand rabbit. Therefore, the authors recommend the use of this breed as a model to study undescended testes (cryptorchidism), testicular cancer and varicocele. Nevertheless, the chinchilla rabbit presents advantages and disadvantages in biomedical protocols on male fertility alterations; the advantage is greater when the design of the research compares some characteristics that correspond to human reproductive physiology.

FEED EVALUATION & FEEDING

INFLUENCE OF SUBSTITUTION OF ARTICHOKE LEAVES FOR CLOVER HAY ON GROWTH PERFORMANCE AND DIGESTIBILITY IN RABBITS

FAWZIA A.H.

Animal Production Research Institute, Agricultural Research Center, 12618 CAIRO, Egypt.

fawzia_amer@yahoo.com

Seventy five New Zealand White (NZW) rabbits, 5 wk of age with 700 ± 1.4 g (mean \pm standard error) average live body weight (LBW) were allotted at random to 5 experimental groups (of 15 rabbits each). The aim of the study was to investigate the effects of partial or complete substitution (0, 25, 50, 75 or 100%) of artichoke leaves (AL) for clover hay on growth performance and nutrient digestibility in rabbits. Results indicated that rabbits fed 50% artichoke leaves recorded the highest ($P < 0.05$) final body weight (2.148 kg) followed by rabbits fed 75% (2.046 kg). Average daily feed intake increased significantly ($P < 0.05$) with the increase of the inclusion level of artichoke leaves throughout the experimental periods. Group fed 50% AL recorded the best feed conversion ratio (FCR) throughout the whole period (W5-W12). In addition to the highest nutrient digestibility, values were recorded for diets containing 50% AL, followed by diet containing 75% AL, while the lowest values were obtained for diet containing 100% AL in comparison to the basal diet. Data also showed that 50% and 75% AL recorded the highest ($P < 0.05$) value of digestible crude protein (DCP) and digestible energy, while rabbits fed diets concerning 100% recorded the lowest ($P < 0.05$) DCP. 50% AL recorded the highest total volatile fatty acids concentration, cellulolytic bacterial count (8.08 log cfu/mL) and fibrolytic activity. It was concluded that substitution of AL in the diet of NZW rabbits at 50% of clover hay had the best growth performance and digestibility of all nutrients.

EFFECTS OF PRE- OR POSTNATAL DIETARY PHYTOADDITIVE (*ECHINACEA PALLIDA*) ON GROWING RABBIT PERFORMANCE, CARCASS CHARACTERISTICS AND IMMUNITY

KOVITVADHI A.*, GASCO L.*, DABBOU S.*, GAI F.[†], FALZONE M.[‡], VIGNOLINI C.[‡], NEBBIA P.[‡], ROSATI S.[‡], ZOCARATO I.*

*Department of Agricultural, Forest and Food Sciences, University of Torino, Largo P. Braccini 2, 10095 GRUGLIASCO, Torino, Italy. [†]Institute of Science of Food Production, National Research Council, Largo P. Braccini 2, 10095 GRUGLIASCO, Torino, Italy. [‡]Department of Veterinary Sciences, University of Torino, Largo P. Braccini 2, 10095 GRUGLIASCO, Torino, Italy. attawitthai@hotmail.com

Echinacea pallida (EP), with immunomodulation and anti-oxidative properties, was selected to study the effects on performance, carcass characteristics and immunity. Twenty mature Grimaud does were randomly divided into 2 groups of 10 which were fed a commercial basal diet without integration of EP (untreated does, C) or with 0.3 mg/kg of EP (treated does, E) for 96 from 98 d of age. At 2nd parturition, 80 kits (35-d-old) from 194-d-old

does were randomly separated into 4 groups of 20 and fed a growing commercial basal diet with (with 0.3 mg/kg of EP) or without the integration as follow: CC (basal diet from the C does), CE (treated diet from the C does), EC (basal diet from the E does) and EE (treated diet from the E does). Performance and health status were evaluated from weaning to 77 d old. At 89 d of age, 10 rabbits from each group were selected for slaughter to perform carcass characteristic analyses and phagocytosis tests. At 95 d of age, the remaining 10 rabbits per group were treated with a vaccine against rabbit hemorrhagic disease virus. The serums were collected at 88, 102, 109, 116 and 123 d of age to evaluate specific antibody responses. Two-way ANOVA was performed (maternal and diet effect as fixed factors). In conclusion, the dietary supplementation by EP in does promoted heavier slaughter weight (SW) and higher average daily gain in their kits, whereas treated diets fed to fattening rabbits induced a decrease of SW, a higher feed conversion rate and a phagocytic activity improvement.

PRODUCTION INDICATORS AND CARCASS CHARACTERISTICS OF MEAT RABBITS SUPPLEMENTED WITH PHOSPHORUS AND CYANOCOLABAMIN

SUÁREZ R.D.A.*, RODRÍGUEZ D.L.R.*, MARIEZCURRENA B.M.A.[†], MARIEZCURRENA B.M.D.[†], ARANDA O.G.*

*Universidad Autónoma Chapingo, Carretera México-Texcoco km. 38.5, México. [†]Universidad Autónoma del Estado de México, Carretera Toluca-Atzacmulco, desviación hacia Tlachaloya, EL CERRILLO, Piedras Blancas. México.

mvzsolucionesprofesionales@hotmail.com

The aim of the present work was to evaluate the production indicators in New Zealand White rabbits supplemented with Catosal at different doses. The experiment was carried out with 100 New Zealand White rabbits aged between 24 to 29 d old. The animals were weighed and sexed, then wormed with Fenbendazole (35 mg/kg) and supplied with sodium sulfamonomethoxine (50 mg/kg). The treatments were: T1: 3 mL of physiologic saline (control group); T2: 2 mL of Catosal; T3: 3 mL of Catosal and T4: 4 mL of Catosal. We administered 6 doses in each treatment every 7 d. Five rabbits housed in a European type cage constituted an experimental unit. Plus, 20 experimental units were set up with average weights between 3635 a 4185 g. The rabbits were fed *ad libitum* with commercial feed; every 7 d they were weighed to determine weekly and daily gain, consumption and food rejection, feed conversion and slaughter weight. The weight gains were improved ($P = 0.0094$) and the residual food was the case ($P < 0.0001$).

NUTRITIONAL CHARACTERISATION OF *SALVINIA AURICULATA* FODDER, GROWN IN AQUAPONICS FOR RABBIT FEED, PRELIMINARY RESULTS

GUERRERO C.E.M.*, ALBERTOS A.P.J.*, MARTÍNEZ Y.R.*†, MAGAÑA R.J.J.*, GUZMÁN M.R.*, PARADA H.R.†

*Departamento de Agronomía, División de Ciencias de la Vida, Universidad de Guanajuato. †Centro Nacional de Cunicultura, México.

rosario.mtzy@gmail.com

The aim of this study was to nutritionally characterise *Salvinia auriculata* fodder grown in aquaponics systems as alternative forage for rabbit feeding. The control diet was *Medicago sativa*, and both fodders were fed as hay (85 and 89% dry matter, respectively). Voluntary feed intake and apparent digestibility of dry matter (DM) were evaluated. For the study, 24 specimens of *Oryctolagus cuniculus* Californian breed were used (48 to 53 d old, 1079±73 g, 50% males and 50% females) which were obtained from females in the Centro Nacional de Cunicultura (CNC, México) animal nucleus and reproduced in controlled conditions. Study was carried out on the CNC premises. The animals were individually kept in galvanised cages (60×90×40 cm), with basket for forage feeders and automatic water dispensers. The experiment lasted 11 d, 7 for forage adaptation and the last 4 for sampling. Every day at 9 a.m. fodder (*S. auriculata* and *M. sativa*, 60 and 90 g, respectively) was offered, 24 h later refusals and faeces were collected. Data were analysed using Student's T-test. Preliminary results indicate that *S. auriculata* hay has a lower DM intake compared to *M. sativa*, 24.94±2.8 and 48.72±2.9 g/d, respectively (mean±standard error). DM digestibility was lower for *S. auriculata* than *M. sativa*. However, the possibility of using this fodder cannot be ruled out completely, as DM digestibility values of 45.35 and 70.33% were observed for *S. auriculata* and *M. sativa*, respectively.

EVALUATION OF KOMBUCHA TEA NUTRITIONAL SUPPLEMENT AND *SACCHAROMYCES CEREVISIAE* SC47 ON PRODUCTION PARAMETERS IN NEW ZEALAND RABBITS DURING THE FATTENING STAGE

PÉREZ S.L., DE LA CRUZ B.A., DÍAZ-GONZÁLEZ B.A., LAGUNAS B.S., FAJARDO M.R.

Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Facultad de Medicina Veterinaria y Zootecnia (FMVZ), Universidad Autónoma de México (UAEMex). Carretera Toluca-Atlacomulco, km. 15.5. CP. 50200. TOLUCA, México.

raul_fajard@hotmail.com

This is the first report on the effects of Kombucha tea (KT) and *Saccharomyces cerevisiae* (Sc47) probiotics in rabbit production. The objective of the present study is to

evaluate the effect of KT supplement, which is only used for humans, as well Sc47 yeast strain, during the fattening phase in New Zealand rabbits. In a first experiment, 30 four-week-old weaned rabbits were used. They were distributed randomly into 3 treatments: KT A, Sc47 B and Control C, with 10 repetitions each. In the other research, 30 five-week-old rabbits with the same distribution characteristics as in the first experiment were used in both trials, regardless of gender. KT was provided in drinking distilled water during the treatments at doses of 2 mL/kg. In treatment B, Sc47 was added at doses of 2 mL with a yeast concentration of 0.014 g containing 77000 colony-forming units per mL, diluted in drinking water. For group C, food and water only were supplied. For both experiments, a commercial additive-free diet free was used. The results in total food intake, weight gain, nutritional conversion and carcass yield were not statistically significant ($P>0.05$). However, analysis of the production parameters at the point when the animals of group A reached 2 kg weight showed statistically significant differences in the above-mentioned parameters ($P<0.05$), as the animals reached the 2 kg goal 4 d earlier than the control group. Furthermore, the KT doses used in treatment A did not represent a health risk to the rabbits in the experiment.

EFFECT OF DIETARY PROTEIN CONTENT ON SECOND REPRODUCTION CYCLE OF LOCAL RABBIT DOES AND THEIR LITTERS

SAIDJ D.*, AINBAZIZ H.*, DAHMANI Y.*, ILES I.*, BENALI N.*, CHIRANE M.*, MOULA N.†

*Research Laboratory "Animal Health and production", High National Veterinary School, EL-HARRACH PB 161, 16200, Algiers, Algeria. †Département of Animals Productions, Faculty of veterinary Medicine, University of Liège, Boulevard de Colonster, 20 bâtiment B43, 4000 LIÈGE, Belgium.

dyhiasdj1@yahoo.fr

The influence of diet protein content on reproductive performance and milk production was studied in 46 local rabbit does with effect on their litters during the 2nd lactation. Does were divided into 3 groups offered one of 3 diets formulated to give the same digestible energy (DE) content (2600 kcal) and different digestible protein (DP) content (15, 17 and 19% DP for diet T, A and B respectively). Diets were supplied *ad libitum* between parturition and weaning. The use of high protein diets showed no effect in does' weight at partum and between partum and weaning, or, consecutively, does' weight gain during 2nd lactation. Does given B diet showed significantly higher protein intake per day at lactation (58.08 g for group B vs. 52.94 g for group A vs. 44.34 g for group T) ($P<0.01$), but no difference was detected in the digestible energy intake per day and the feed intake per day between

partum and weaning (294.5 g for group T vs. 311.1 g for group A vs. 305.8 g for group B). Litter size and weight at partum and at weaning were not affected by the diets, but the effect of litter size in milk production during 21 d post partum (3 wk of 2nd lactation) was clear in the 3 diets ($P < 0.0001$). There was no significant difference in milk production between the 3 diets.

EFFECTS OF INTERACTION BETWEEN ENERGY CONTENT OF DIET AND PARITY ON PERFORMANCE OF LOCAL RABBIT DOES

SAIDJ D.*, AINBAZIZ H.*, SALHI O.*, BENALI N.*, LEROY P.†, MOULA N.†

*Research Laboratory "Animal Health and production", High National Veterinary School, EL-HARRACH PB 161, 16200, Algiers, Algeria. †Département of Animals Productions, Faculty of veterinary Medicine, University of Liège, Boulevard de Colonster, 20, bâtiment B43, 4000 LIEGE, Belgium.

dyhiasdj1@yahoo.fr

Sixty-one nulliparous local rabbit does were used to study the effect of different energy content in diet and its interaction with parity on their performance and litters at 1st and 2nd lactation. Does were fed one of the 3 experimental diets with the same protein content (15% CP) and different digestible energy content (2300, 2450 and 2600 kcal/kg) for T, A and B diets respectively. Weight of rabbit does and their litters was controlled at parturition and each week post partum. Weaning took place at 28 d of age. Diets were supplied *ad libitum* between parturition and weaning. Rabbit does were submitted to mating at 10 d post partum for 2nd parturition. The use of high energy diets showed no effects in live weight of does between parturitions and weaning, does' live weight gain at lactation and their milk yield, but diet with higher energy content significantly ($P < 0.0001$) decreased feed intake at lactation and daily feed intake. There was no significant difference between diets for size and litter weight from birth to weaning, although interaction between diet and parity was significant ($P < 0.05$). Mortality at partum and at birth to weaning did not differ significantly ($P < 0.05$). There was a significant difference between parities on the main reproduction parameters ($P < 0.05$).

EFFECTS OF FEED RATIONING, FASTING AND A HERBAL SUPPLEMENT ON MORTALITY AND PERFORMANCE OF FATTENING RABBITS IN ERE CONDITIONS

DUPERRAY J.*, GRAND E.*, WEISSMAN D.*, LAURENT J.M.*, LAUNAY C.†, BELTRAN J.†

†IN VIVO NSA, Talhouët, B.P. 234, 56006 VANNES Cedex, France. †MALTA CLEYTON, Poniente 134, N° 786, Colonia Industrial Vallejo, MEXICO D.F. CP 02300. México.

jduperray@evalis.net

Rabbit breeders use a range of strategies in their attempt to minimise the digestive problems caused by ERE (Epizootic Rabbit Enteropathy). Feed rationing is one practice that effectively reduces health problems of a digestive nature. The aim of this article is to provide an overview of 2 studies conducted in ERE conditions. Restricted feeding was compared to *ad libitum* feeding. Some animals on a restricted intake were also subjected to a fast, and some of the *ad libitum* fed animals received Vegeplus, a plant-based supplement, added to their feed. Rabbits were fattened up in ERE conditions to the age of 67 d. They were weighed individually at 53 and 67 d and the consumption of each cage was determined at these same ages. Mortality was monitored daily. Some of the animals were necropsied at different points of the fattening; the diagnosis was death from digestive disorders, with most animals being diagnosed with ERE. These studies in ERE conditions have shown the health benefits of feed restriction for fattening rabbits. Imposing a fast on animals already on restricted intake provides no additional health benefits; instead, it severely penalises the growth performance of the rabbits. Although this technique is often practised by breeders who feed their animals *ad libitum*, it has less of a place in restricted intake techniques, where the most effective way of imposing a fast has yet to be determined. Adding the natural plant extract Vegeplus to feed reduces mortality and improves production. When a health risk is present, the digestive security it provides reduces the need for feed restriction.

NUTRIENT DIGESTIBILITY STUDIES IN RABBIT INTAKE DIETS WITH THE ADDITION OF PROBIOTIC SUBTILPROBIO® (*BACILLUS SUBTILIS* AND ENDOSPORES)

DIHIGO L.E.*, RUBIO S.H.†, RONDON A.J.‡, DOMÍNGUEZ M.*, SARDUY M.L.*

*ICA, Institute of Animal Science. CC. km 47½, SAN JOSÉ DE LAS LAJAS. Cuba. †LABEX, Laboratories Biological Pharmaceutical. SANTIAGO DE CUBA. Cuba. ‡UM, University of Matanzas " Camilo Cienfuegos. MATANZAS, Cuba.

dihigo297@gmail.com

The use of probiotics in rabbits can improve feed efficiency by improving gut integrity, nutrient absorption and digestive behaviour. To determine the digestibility of nutrients in rabbit intake diets with a probiotic mixture of *Bacillus subtilis* endospore (Subtilprobio®), 20 male rabbits of New Zealand White breed with 90 d of age and an average weight of 2.2 kg housed in individual metabolism cages

were used. They were distributed according to a completely randomised design in 2 experimental groups: control and experimental without probiotic, with 10 repetitions each. The probiotic was mixed in the diet at a rate of 1 L/ton of feed. During the 15 d that the experiment lasted, the last 5 d intake and faecal excretion were measured. Digestibility of dry matter (DM), crude protein (CP), organic matter (OM), neutral detergent fibre (NDF) and Ash (C) were measured. Differences for intake, excretion g of DM and OM digestibility were not observed. Rabbits that consumed the probiotic significantly improved ($P<0.05$) and ($P<0.01$) digestibility of DM and NDF values of 72.79 vs. 77.98% and 54.26 vs. 64.11%, respectively. Similarly, the greater digestibility ($P<0.001$) of CP was observed in animals fed the probiotic with values 79.14 vs. 87.38 %, respectively. It was concluded that the use of Subtilprobio® in rabbit diets improved indicators of digestibility for DM, NDF, and CP.

GROWTH PERFORMANCE AND CAECAEAL PARAMETERS OF RABBITS FED THREE DIFFERENT TROPICAL BROWSE PLANTS

SALMA H.A.H.* , ABDELFAHAT Z.M.S[†], AYMAN A.H.[‡]

*Livestock Research Department, Arid Lands Cultivation Research Institute, City of Scientific Research and Technological Applications, New Borg El-Arab, ALEXANDRIA, Egypt. [†]Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, México. [‡]Animal Production Research Institute, Ministry of Agriculture, Dokki, Giza, Egypt. asalem70@yahoo.com

A 60-d feeding trial was employed to investigate dried leaves and stems of *Acacia saligna*, *Leucaena leucocephala* and *Moringa oleifera* on the performance, digestibility, nitrogen utilisation and caecum characteristics of weaned New Zealand White (NZW) rabbits. Fifty-four weaned male NZW rabbits (average weight ranged from 785-850 g) were divided into 3 groups and used to study 3 experimental diets in a completely randomised design. The dried *A. saligna*, *L. leucocephala* and *M. oleifera* leaves and stems were ground and incorporated separately at a level of 15% in diets for each group (18 rabbits/group). The results of digestibility coefficients, nutritive value, nitrogen utilisation and dry matter intake of rabbits fed shrubs of *M. oleifera* and *L. leucocephala* were significantly ($P<0.05$) higher than those fed shrubs of *A. saligna*. Moringa diet resulted in an average weight gain of 22.7 g/animal/d, comparable ($P<0.05$) to the value of 13.2 and 20.1 g/animal/d for *Acacia* and *Leucaena* diets, respectively. However, *Acacia* diet had the lowest average weight gain (13.2 g/animal/d). Feed conversion and protein efficiency ratios were significantly ($P<0.05$) better for rabbits fed on the Moringa diet (4.5 and 1.4) than those fed on *Acacia* and *Leucaena* groups (6.68 and 0.92) and (4.9 and 1.2), respectively. Caecal ammonia-N concentration was significantly

($P<0.05$) higher for animals fed *L. leucocephala* than those fed *M. oleifera* and *A. saligna* diets. However, VFA concentration was significantly ($P<0.05$) higher for rabbits fed *M. oleifera* than those fed *A. saligna*. Total microbial count in caecum, *E.coli* and *Lactobacillus* bacteria, were significantly ($P<0.05$) lower for rabbits fed *M. oleifera* followed by *L. leucocephala*. Based on the results, the high potential of locally available fodders such as Moringa and *Leucaena* appeared promising as protein source for rabbits with a better prospect of utilisation. They may be added an asset in developing countries where less protein sources are available for animal consumption.

INFLUENCE OF ANAEROBIC PROBIOTIC ON SOME PHYSIOLOGICAL ASPECTS AND REPRODUCTIVE CAPABILITY OF PRE-MATURE RABBITS

GADO H.* , SALEM A.Z.M.[†]

*Animal Production Department, Faculty of Agriculture, Ain Shams University, QALUBIA, Egypt. [†]Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, TOLUCA, México
asalem70@yahoo.com

This study was designed to evaluate pre-mature Hy-Plus rabbit performance as affected by different levels of anaerobic probiotic of ZADO® (EZ) in diets. Animals were divided into 4 comparable experimental groups (4 males and 8 females in each) in completely random design. The 1st group was fed a commercial diet and kept untreated (Control group), while the 2nd, 3rd and 4th groups (treated groups) were fed the same diets but supplemented with 1 (EZ1), 3 (EZ3) and 5 (EZ5) kg ZADO®/ton of diet, respectively. The study was carried out during pre-mature period (from marketing age at 60 d up to age at 1st mating). Blood samples were taken from animals at the end of the experiment to determine blood profiles, total protein and its fractions, enzymes of liver activity and kidney function and lipid. Supplementation of EZ in diets increased ($P<0.05$) blood pictures, total protein and its fractions, liver activity and kidney function. Some physiological aspects indicated physiological ability of body-thermoregulation represented in temperatures of each of ear lobe, skin and rectal and respiration and pulse rates were decreased ($P<0.05$) with EZ supplementation. Feeding diets containing different levels of EZ to pre-mature rabbits decreased ($P<0.05$) age and increased ($P<0.05$) body weight at first mating. Live body weight, absolute and relative weight of gonads and pituitary gland, as well as scrotal circumference and testicular index, improved ($P<0.05$) in treated rabbits vs. control. Male or female Hy-Plus rabbits fed diets supplemented with different levels of EZ induced an improvement ($P<0.05$) in all physiological parameters and reproductive capabilities studied. This improvement

was arranged ($P < 0.05$ or 0.01) in descending order from EZ5 to EZ3 and then EZ1, with no difference between EZ3 and EZ5 groups. It can be concluded that supplementation of ZADO[®] to rabbit diets showed an essential role in improving immunity, liver and kidney functions, body thermoregulation, age and weight at 1st mating, weight of gonads and pituitary glands, testicular index and scrotal circumference during pre-mature period, due to multi exogenous enzymes of ZADO[®]. From the economic viewpoint, 3 kg ZADO[®]/ton diet is recommended for pre-mature rabbits.

STUDY OF THE CONSUMPTION EFFECT OF PROBIOTICS ON COLIFORM DYNAMICS IN RABBIT DIGESTIVE TRACT

LAGUNAS B.S., PÉREZ S.L., OSORIO M.J., FAJARDO M.R., DE LA CRUZ B.A., DÍAZ-GONZÁLEZ B.A.

Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Facultad de Medicina Veterinaria y Zootecnia (FMVZ), Universidad Autónoma de México (UAEMéx). Carretera Toluca-Atzacmulco Km. 15.5. CP. 50200. TOLUCA, México.

raul_fajard@hotmail.com

In a previous work, we demonstrated that *Saccharomyces cerevisiae* and Kombucha tea probiotics enhanced some productive parameters in rabbits, and modified the intestinal coliform microflora, but the modified bacteria population strains remain unidentified. The aim of this study was to identify the intestinal bacteria strains that changed under the effect of probiotic oral supply. This work was carried out under an observational descriptive design in 30 New Zealand White rabbits, divided into 3 treatment groups of 10 animals each, for 75 experimental days, using a commercial additive-free feed. Group A was supplemented with KT. Group B with Sc47 and group C served as control. Stool samples from anal sphincter were taken and seeded on selective media for coliforms. A number of 61 bacterial colonies was isolated and identified as: 27 Gram-positive diplococci and cocci, 34 Gram-negative coliform, identified as 3 *Citrobacter intermedium* colonies, 3 *E. coli*, one *Alcaligenes faecalis*, 2 *Yersinia*, 1 *Salmonella arizonae*, 13 *Serratia marcescens*, 1 *Flavobacterium* spp., 3 *Vibrio cholerae*, 3 *Serratia liquefaciens*, 1 *Erwinia herbicola*, 2 *Aeromonas* spp. and 1 *Proteus vulgaris*. These results show a bacterial intestinal modulation induced by probiotic consumption.

USE OF FODDER RESOURCES IN REGIONAL RABBIT MEAT PRODUCTION IN MARGINAL AREAS OF THE STATE OF PUEBLA, MEXICO

GARCÍA S.F., CAMACHO R.J.C., HERNÁNDEZ H.J., VILLARREAL E.O., MARTÍNEZ P.S.

Facultad de Ciencias Veterinarias, Benemérita Universidad Autónoma de Puebla, PUEBLA, México.

sersocialflorenia@hotmail.com

This research was conducted in the town of Libres, Puebla, Mexico to determine the nutritional value of food formulas: fresh alfalfa, barley, oat forage in milk stage and minerals, compared to the formula: fresh alfalfa, corn, oat milk, minerals, and its effects on meat quality in 20 rabbits, evaluating fertility, weight gain, carcass size: length, width, colour and pH; to reduce production costs and their influence on the performance of functions at each stage of rabbit production. Each food was subjected to proximal chemical analysis at the Laboratory of Nutrition, Faculty of Veterinary Medicine and Animal Husbandry-UNAM.

EFFECTS OF DIETARY ARGININE SUPPLEMENTATION DURING WHOLE PREGNANCY ON THE REPRODUCTIVE PERFORMANCE AND PLASMA BIOCHEMICAL PARAMETERS OF RABBIT DOES

SONG W., QIN Y.

College of Animal Science and Technology, China Agricultural University, No.2 Yuanmingyuan West Road, Haidian District, BEIJING 100193, P.R.China.

qinyinghe@cau.edu.cn

The effect of dietary arginine supplementation during whole pregnancy (from day 0 to 31 of gestation) on the reproductive performance and plasma biochemical parameters of rabbit does was studied. A total of 223 good body condition Hyla parent rabbit does with body weights of 4268 ± 206 g were assigned randomly into 3 groups based on body weight, representing the control, 0.4% Arg treatment, and 0.8% Arg treatment. Control rabbits were fed a basal diet, the 0.4% Arg rabbits were fed a basal diet supplemented with 0.4% L-arginine, and the 0.8% Arg rabbits were fed a basal diet supplemented with 0.8% L-arginine. Reproductive performance, feed intake and body weight changes in the rabbits, as well as plasma amino acids, urea, nitric oxide (NO), total nitric oxide synthase (T-NOS) concentration on d 0, 10, 20 of gestation were measured. The results showed that dietary supplementation with L-arginine throughout pregnancy markedly enhanced the reproductive performance of rabbit does. Compared with the control group, 0.4% Arg supplementation increased liveborn kits by 1.28 per litter ($P > 0.05$), litter birth weight of all kits born alive by 78.4 g per litter ($P > 0.05$), and litter birth weight of all kits born by 39.17 g per litter ($P > 0.05$). For rabbits in the 0.8% Arg supplementation group, kits born alive increased by 2.21 per litter compared with the control group ($P < 0.01$), litter birth weight of all kits born alive increased by 142.86 g per litter ($P < 0.01$), litter birth weight of all kits

born increased by 111.33 g per litter ($P<0.01$), and there was a significant improvement compared with the control group. There were no significant differences for the other parameters, such as total number of kits born, number of kits stillborn, litter birth weight of all kits stillborn, and average birth weight of kits born alive, between treatment groups ($P>0.05$). Moreover, compared with the control group, 0.8% Arg supplementation sharply increased the average daily feed intake of the rabbits by 20.89 g/d ($P>0.05$). On day 0 of gestation, the plasma indicators did not differ among the 3 treatment groups. On day 10 of gestation, 0.4% Arg supplementation markedly increased plasma arginine, glycine, hydroxyproline, NO, T-NOS concentrations ($P<0.05$), and 0.8% Arg supplementation markedly increased plasma arginine, isoleucine, methionine, threonine, glycine, ornithine, hydroxyproline, urea, NO, T-NOS concentrations ($P<0.05$), but both arginine supplementation groups showed a marked decrease in plasma phenylalanine concentration ($P<0.05$). On day 20 of gestation, 0.4% Arg supplementation markedly decreased plasma alanine concentration ($P=0.004$), and 0.8% Arg supplementation markedly increased plasma arginine and ornithine concentrations ($P<0.05$), while other biochemical indexes did not differ ($P>0.05$). Therefore, dietary supplementation with arginine throughout pregnancy could improve the number of kits born alive, live litter birth weight and total litter birth weight, as well as the metabolism of amino acids in the blood and an increase in the synthesis of NO and the expression of T-NOS.

PATHOLOGY & HYGIENE

STUDY OF THE EFFECTS OF *SACCHAROMYCES CEREVISIAE* AND KOMBUCHA TEA ON THE INTESTINAL MICROBIOTA OF RABBITS

PÉREZ S.L., LAGUNAS B.S., DE LA CRUZ B.A., FAJARDO M.R., DÍAZ-GONZÁLEZ B.A.

Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Facultad de Medicina Veterinaria y Zootecnia (FMVZ), Universidad Autónoma de México (UAEMex). Carretera Toluca-Atzacomulco, km. 15.5. CP. 50200. Toluca, México.
raul_fajard@hotmail.com

Saccharomyces cerevisiae (Sc47) yeast has been used in the feeding of several domestic animal species and humans, and symbiotic Kombucha tea (TK) has been used in humans, both as an alternative therapy and to enhance health. The mechanisms of these effects are not known, and it is thought that they might be associated with a modification of the intestinal flora. In this work, the effects of these probiotics on faecal coliform populations isolated in rabbit were evaluated. The experimental model was

3 groups of adult rabbits, without contact with probiotics. The Sc group received 0.3% commercial Sc47, and the TK group received 2 mL/kg body weight of commercial TK. A stool sample was taken from all animals in the experimental group on days 0, 7, 14 and 21; seeding on selective media for coliform/g of faeces; isolation, counting and identifying of bacterial species was performed using samples from experimental days 0 and 21. The results showed that both probiotics increased faecal coliform populations ($P<0.05$). The culture supernatants of Sc47 had no antimicrobial effect on the isolated bacterial genera. Kombucha supernatant had an inhibitory ($P<0.05$) effect on the genera *E. coli*, *Plesiomona* spp., *Serratia* spp., *Salmonella* spp., *Yersinia* spp., *Acinetobacter*, *Pseudomonas* spp., *Actinobacillus* spp., *Moraxella* spp., *Alcaligenes* spp., *Pasteurella* spp. Both probiotics modulated faecal coliform populations in rabbits by different mechanisms; antimicrobial and/or by competitive exclusion. Although it has been reported that some probiotics can modulate the intestinal microbiota by acidification of the medium, in this study no changes in pH were observed. Mechanisms of intestinal microbiota modulation induced by probiotics are poorly understood, so further studies are required.

RENAL AND HEPATIC EVALUATION DUE TO CADMIUM EXPOSURE IN RABBITS

REYES-ÁNGELES J.F.*, CASTRO-GANDARILLA J.*, VELÁZQUEZ-ORDÓÑEZ V.*, LEE-MORENO J.L.†, TREMARI-TRUEBA R.M.†, ALONSO-FRESÁN M.U.*, BARBABOSA-PLIEGO A.*, VALLADARES-CARRANZA B.*

*Centro de Investigación y Estudios Avanzados en Salud Animal. Facultad de Medicina Veterinaria y Zootecnia. UAEM. Km 15.5, Carretera Toluca-Atzacomulco, Toluca, Estado de México, C.P. 50200, México. †Servicio Geológico Mexicano, Centro Experimental de Oaxaca, Desviación a San Lorenzo Cacaotepec, S/N, SAN PABLO ETLA, Oaxaca. C.P. 68258. México.
jaz_min_63@hotmail.com

Cadmium is nowadays regarded as an environmental pollutant. Epidemiological studies have demonstrated the association between its exposure and functional alterations due to high atmospheric levels, because it is not biodegradable and for its long-lasting persistence. The aim of this study was to screen and analyse the effects on renal and hepatic functionality due to drinking water pollution (well source) in a rabbit farm near the industrial zone in Mexico City. Five periods were sampled, in which 6 rabbits were randomly selected, collecting 4 mL of blood from the marginal auricular vein in tubes with and without anticoagulant. The first samples were taken when the rabbits were aged 8 wk and on days 15, 30, 45 and 60. Samples were centrifuged and serum obtained to determine ALT (alanine aminotransferase), AST (aspartate transferase), GGT (gamma glutamyl transferase), urea,

creatinine, haematocrit and total proteins, comparing the results to those previously reported in the literature. An initial ALT activity of 63 ± 8.87 U/L was found, in the 1st period 93 ± 12.62 U/L, in the 2nd, 95 ± 6.11 U/L, in the 3rd, 112 ± 10.58 U/L, and in the fourth, 68 ± 19.55 U/L. Regarding GGT and AST, values reported were within normal ranges. Urea showed an increasing value up to 29 ± 3.18 mmol/L, with an initial value of 20 ± 7.30 mmol/L. Creatinine initial concentration was 111 ± 13.57 μ mol/L, increasing up to 118 ± 8.99 μ mol/L in the last period. Haematocrit significantly decreased from 42 ± 4.31 % down to 30 ± 13.23 % in the 4th period. Total proteins slightly increased from 6.2 ± 0.46 to 6.5 ± 1.06 g/dL in the last period. These parameters show that rabbits which have been exposed to cadmium suffer physiological changes that may permanently alter hepatic and renal function.

PERIODONTAL MANDIBULAR OSTEOMYELITIS IN TWO NEW ZEALAND RABBITS

FAJARDO M.R.C., ALPÍZAR P.A., HERNÁNDEZ M.H., FERNÁNDEZ R.P., ORTEGA S.C., MARTÍNEZ C.J.S.

Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA), Facultad de Medicina Veterinaria y Zootecnia (FMVZ), Universidad Autónoma de México (UAEMex). Carretera Toluca-Atlaconulco, km. 15.5. CP. 50200. TOLUCA, México.

raul_fajard@hotmail.com

Mandibular osteomyelitis is an inflammation of all structures of the jawbone caused by microorganisms that enter through tooth decay (odontogenic) or periodontal tissues. The odontogenic form is more common in humans and originates from decayed teeth where infection can reach the bone and cause osteomyelitis. Periodontic mandibular osteomyelitis originates from the tissues that surround and support the teeth: gingiva, periodontal ligament and alveolar bone, due to the accumulation of plaque and tartar, which may form a dental abscess. In rabbits, mandibular odontogenic osteomyelitis is rare and may be related to the diet of pet rabbits. However, periodontal osteomyelitis is common and develops due to the weakness of the periodontal ligament in lagomorphs that allows continuous tooth growth. We did not find reports in scientific journals of this condition, but it has been clinically described in some books. The descriptions in these documents cite purulent osteomyelitis associated to other microorganisms. The aim of this paper is to present and discuss the pathologic findings, etiology and nomenclature of these cases. Two New Zealand rabbits were submitted to the CIESA-FMVZ-UAEMex due to the presence of bilateral submandibular nodes. These cases were characterised by a granulomatous osteomyelitis with a high number of epithelioid cells and lymphocytes in the bone marrow in the lower jaw which agents were involved

Pasteurella multocida and *Bordetella bronchiseptica*. In all cases of osteomyelitis, the dental injuries should be inspected to determine the origin of this disease and so diagnose it properly. Hence, the term periodontal or odontogenic, as indicated, must be added to the name of this disease.

CLINICOPATHOLOGIC STUDY OF *BORDETELLA BRONCHISEPTICA* IN RABBITS SUBMITTED FOR DIAGNOSIS AT CIESA-UAEMÉX

VALLADARES C.B., ZAMORA E.J.L., CASTRO M.J., GUTIÉRREZ C.A., VELÁZQUEZ O.V., ORTEGA S.C., PÉREZ S.L.S, ALONSO F.U., VEGA C.L.F.

Centro de Investigación y Estudios Avanzados en Salud Animal (CIESA). Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México. km. 15.5, carretera Toluca-Atlaconulco. C.P. 50200. TOLUCA, Estado de México, México.

benvac2004@yahoo.com.mx

Bordetella bronchiseptica has been recognised as a cause of respiratory disease in domestic animals. As a primary agent it can cause several diseases in animal, such as: kennel cough (dogs), snuffles (rabbits) and atrophic rhinitis (pigs). In view of the important implications it has for human health, we present a case report of a rabbit farm with 2000 animals where 35-60 d old rabbits were affected, showing respiratory signs (dyspnea, serous nasal secretion) and green diarrhoea. At necropsy, the most revealing findings were severe pulmonary congestion in craneoventral regions, suppurative and fibrinous exudates with presence of adherences to the thoracic wall and suppurative secretion when sliced. Microscopic changes include severe congestion, haemorrhagia, great amounts of oedema and fibrinous material with infiltration of neutrophils and macrophages and an interstitial thickening due to accumulation of infiltrated mononuclear cells. The lung bacteriological isolation reported *Bordetella bronchiseptica* (++) . The importance of this case is based on the repercussions on public health, considering that some human infections for this agent have been related to human contact with infected rabbits.

METICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS* (MRSA) IDENTIFIED IN A RABBIT FARM

VELÁZQUEZ-ORDÓÑEZ V.*, GARCÍA-GAMA A.†, JUÁREZ-TRUJILLO J.C.*, RODRÍGUEZ-CORREA J.L.†, VALLADARES-CARRANZA B.*, ALONSO-FRESÁN M.U.*, TALAVERA-ROJAS M.*, PÉREZ-SOTELO L.*

*Centro de Investigación y Estudios Avanzados en Salud Animal. Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México Cuervo

Académico en Salud Animal (UAEM-CA-3 Salud Animal). Km 15.5 carretera Toluca-Atzacmulco, Estado de México. *Programa de Ciencias Agropecuarias y Recursos Naturales – UAEM. Área Salud Animal. Centro de Investigación y Estudios Avanzados en Salud Animal. Km 15.5 carretera Toluca-Atzacmulco, Estado de México.

vvo@uaemex.mx

Staphylococcus aureus infection may affect rabbit production economically due to superficial and deep dermal infections, mastitis, pododermatitis and septicaemia. ORSA/MRSA antibiotype represents a potential risk to public health. The aim of this work was to identify ORSA/MRSA *S. aureus* antibiotype in a rabbit farm. An ulcerative dermatitis case was studied, from a farm located in Toluca Valley in which the rabbit population had dermal infections and chronic abscesses. Swabs were taken and a biopsy performed for histopathological examination, after sedation with xylazine - ketamine (0.1 mg/kg/25 mg/kg) and butorfanol (0.4 mg/kg) administered intramuscularly. Mannitol salt agar plates were cultured at 37°C for 24 h. *S. aureus* was identified using bacteriological routine procedures. Gram stain, catalase and coagulase tube tests using rabbit plasma, Voges Proskauer, nitrate broth, anaerobic mannitol fermentation and aerobic maltose tests were performed. *In vitro* tests for sensitivity to β -lactamic antibiotics were evaluated through diffusion method in Mueller-Hinton (MH) agar using amoxicillin/clavulanic acid unidiscs (10/20 mg), which were incubated at 37°C (NaCl 4%) and oxacillin-meticillin unidiscs (1 μ g and 6 μ g) incubated at 35 and 42°C. Results showed *S. aureus in vitro* resistance to all antibiotics. Histopathologically, a proliferative granulomatous reaction was observed, with tissue necrosis and capillary neoformation. It is concluded that *S. aureus* ORSA/MRSA antibiotype was present in the rabbit farm, therefore representing a public health risk due to the possibility of human infections developing from animal sources.

NON DESTRUCTIVE STANDARDISED METHOD TO DETERMINE BACTERIAL CONTAMINATION BY *STAPHYLOCOCCUS AUREUS* IN RABBIT CARCASSES

GARDUÑO-GUADARRAMA V.*, VELÁZQUEZ-ORDÓÑEZ V.†, ALONSO-FRESÁN M.U.†, ZAMORA-ESPINOSA J.L.†, TALAVERA-ROJAS M.‡, DOMÍNGUEZ-VARA I.A.#, MENDOZA-BECERRIL J.#

*Programa de Ciencias Agropecuarias y Recursos Naturales – UAEM. Área salud animal. Centro de Investigación y Estudios Avanzados en Salud Animal. Km 15.5, carretera Toluca-Atzacmulco, Estado de México. †CIESA. Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México. Cuerpo Académico en Salud Animal (UAEM-CA-3 Salud Animal). ‡CIESA. FMVZ. UAEM. #FMVZ. UAEM. El CERRILLO, Piedras Blancas, México.

muaf@uaemex.mx

Rabbit meat is increasingly consumed worldwide, regardless of its microbial counts. There is no specific method to determine the microbial count in rabbit carcasses. This is the main reason for developing a non destructive surface sampling, taking into consideration the sampling method for large species to determine microbial counts for *Staphylococcus aureus*. Fifteen rabbit carcasses were sampled, taking a different surface sample per group (5 rabbits/group). Wet swabs with peptone water were scrubbed in different regions: R1 in the thigh, R2 in the back, R3 in the ribs and R4 in the shoulder (1 rabbit per region). The 4 regions were sampled in 1 rabbit from each group. The surface sampled for Group 1 was 2.5×2,5 cm; Group 2, 5×5 cm and Group 3, 10×10 cm. Serial decimal dilutions were made and cultured in Baird Parker Agar for *Staphylococcus aureus* growth. The best surface for sampling was the smallest. *S. aureus* CFU/cm² in the samples exceeding the national and international maximum limits, representing a hygiene alert due to possible *S. aureus* strain dissemination.

STAPHYLOCOCCUS AUREUS CONTAMINATION EVALUATION IN RABBIT CARCASSES (*ORYCTOLAGUS CUNICULUS*) THROUGH WASHING AND SUPERFICIAL SAMPLING

RODRÍGUEZ-CORREA J.L.*, VELÁZQUEZ-ORDÓÑEZ V.†, VALLADARES-CARRANZA B.†, TALAVERA-ROJAS M.*, ZAMORA-ESPINOSA J.L.†, ALONSO-FRESÁN M.U.†, DÍAZ GONZÁLEZ-BORJA A.E.†, GARCÍA-GAMA A.M.*

*Programa de Ciencias Agropecuarias y Recursos Naturales – UAEM. Área salud animal. Centro de Investigación y Estudios Avanzados en Salud Animal. Km 15.5, carretera Toluca-Atzacmulco, Estado de México. †CIESA. Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México. Cuerpo Académico en Salud Animal (UAEM-CA-3 Salud animal).

vvo@uaemex.mx

Staphylococcus aureus is widely distributed in animal populations intended for meat production. It is an opportunistic pathogen, which causes multiple skin infections and septicaemia in animals and humans through food and interspecies contact. In this study, 2 methods were compared to estimate *S. aureus* microbial load in rabbit carcasses. Sampling was undertaken in the slaughter area of a family production farm in Toluca Valley. Three samples with 3 repetitions were tested by one of the following methods: in method A (MA) an area of 2.5×2.5 cm was delimited in 4 zones of the carcass, in which a swab was scrubbed vertically and horizontally. Swabs were placed in 10 mL 2% peptone water. In method B (MB), the carcass was washed in 400 mL of peptone water, from which 30 mL were taken. Baird Parker agar plates were inoculated and placed at 37°C for 48 h to

determine *S. aureus* microbial load in colony forming units (CFU). Results for MA were 4.8×10^{-4} CFU/cm² and MB 5.0×10^{-4} CFU/mL ($P > 0.05$). There was no statistical difference within methods to estimate carcass microbial load, therefore suggesting the use of superficial sampling due to accessibility.

PREVALENCE STUDY OF EXTERNAL AND INTERNAL PARASITES OF RABBITS IN THE MUNICIPALITY OF LIBRES, PUEBLA, MEXICO

GARCÍA-SEGURA F., ARANDA-ABURTO M.S., ESPINO-BARROS O.A., HERNÁNDEZ-HERNÁNDEZ J., CAMACHO-RONQUILLO J.C., PORTILLO-MONROY A.

Facultad de Medicina Veterinaria y Zootecnia, Benemérita Universidad Autónoma de Puebla, PUEBLA, México.

There are many parasites affecting rabbits, which also affect the income of rabbit producers, but no information is available in local rabbit farms, so the objective of this research was to sample scats from rabbit farms located in the Municipality of Libres, Puebla, Mexico, to identify the parasites, 250 samples were obtained and analysed. The laboratory method used was saturated saline flotation and results obtained were analysed by ANOVA. Some of the parasites identified were: *Coccidia* (*Eimeria magna*), *Toxocara canis* and *Fasciola hepatica*.

DISEASES DIAGNOSED IN RABBITS SENT TO CIESA FROM THE VALLEY OF TOLUCA DURING 2004 TO 2013

ZAMORA E.J.L., VALLADARES C.B., FAJARDO M.R.C.

Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México, El Cerrillo Piedras Blancas, CP 50200, TOLUCA, México, México.

zamoraespinosa@hotmail.com

Disease monitoring in rabbit populations is rarely done and epidemiological surveillance is passive in type; reports are incomplete and isolated, making it imperative that strategies be established to strengthen this production sector, due to its relevance as an alternative food producing species. The purpose of this study is to report the diseases that affect rabbits found in the Valley of Toluca, State of Mexico, Mexico and which were sent for diagnosis to CIESA. Studies that were carried out included necropsy, histopathology and bacteriology of live and dead rabbits of different genders, ages, races and production types, received between 2004 and 2013. From a total of 75 cases, the most frequent diseases were: coccidiosis 14.6%; pneumonia associated with *Pasteurella multocida* and *Bordetella bronchiseptica* 13.7%; mucoid enteropathy 10%; malnutrition 7.3%; salmonellosis 6.4%; hydatidosis

6.4%; interstitial pneumonia 6.4%; hepatic coccidiosis 4.5%; colibacillosis 4.5% and muscle and skeletal disorders 4.5%. The other 21.7% is represented by diseases such as: mycoplasmosis, necrotic hepatitis, otitis by ticks, pyometra, subcutaneous abscesses, psoroptic mange and stress.

USE OF RECORDS TO DETERMINE THE CAUSE OF MORTALITY IN RABBITS AT DIFFERENT TIMES OF THE YEAR IN CHAPINGO AUTONOMOUS COLLEGE EXPERIMENTAL UNIT

HERNÁNDEZ R.M.*, CAMPOS H.M.†, RIVERA M.J.*, HERRERA B.J.‡, NICOLÁS G.A.*, GONZÁLEZ S.J.‡

*Universidad Autónoma Metropolitana Unidad Iztapalapa. Rafael Atlixco No. 186, Col. Vicentina, Delegación Iztapalapa, C.P. 09340, D.F. México. Departamento de Biología de la Reproducción. †Universidad Autónoma de Chapingo. Carretera México-Tezcoco, km 38.5, Tezcoco, C.P. 56250, Estado de México. ‡Universidad Autónoma Metropolitana Unidad Xochimilco. Calzada del Hueso 1100, Col. Villa Quietud, Delegación Coyoacán, C.P. 04960, D.F. México. Departamento de Producción Agrícola y Animal.

marchela_011@hotmail.com

The municipality of Tezcoco has an average altitude of 2250 meters above sea level and its climate is considered temperate semi-dry, with an average annual temperature of 15.9°C and average annual rainfall of 686 mm. Any meat production system relies on the transformation of plants to animal protein of high nutritional value for human consumption. The production of rabbit meat is valuable, especially when providing high protein at low cost, as it is found that the rabbit can transform 20% of dietary protein absorbed into flesh. At the Autonomous University of Chapingo in Mexico, the records were studied and the percentage share of various causes of death (9 categories) of rabbits in different climatic seasons (spring, summer, autumn and winter) and 3 production stages (infant described, fattening and breeding) for a consecutive year (May 2010 - May 2011). During this period, the total rabbit population was 31046. The highest mortality occurred in summer. Pneumonia was the leading cause of death with 53.80%. Pneumonia deaths occurred in a higher percentage during the autumn, where most mortality was detected in suckling and fattening stages with 37.19% and 77.33%, respectively. Digestive diseases were shown to be the leading cause of death in each of the production stages in summer, with 22.40%. We conclude that environmental facilities-effect relationship is an important risk factor for the occurrence of diseases that results in rabbit deaths in all production stages. Therefore, improving animal welfare and cutting economic losses by reducing mortality are factors when root causes are considered correct and the negative effects of risk factors through changes in the management

of the unit are identified. Knowledge of the causes of mortality can be achieved by including this variable in the records kept in production. The more information concerning this variable is achieved to obtain the records, the better the animal handling improvement strategies.

RABBIT (*ORYCTOLAGUS CUNICULUS*) AS A MODEL FOR ANIMAL SURGICAL PROCEDURE OSTEOSYNTHESIS

VICTORIA M.J.M.*, IBANCOVICH C.J.A.*, SÁNCHEZ A.P.†

*Hospital Veterinario para Pequeñas Especies, Universidad Autónoma del Estado de México. México. †Facultad de Medicina Veterinaria y Zootecnia, Universidad Autónoma del Estado de México. México.

mauro_victoria@yahoo.com.mx

Osteosynthesis is a surgical procedure that allows the stabilisation of bone fragments by metal implants in contact with bone (internal fixation), such as plaques, nails, screws and wire, among others. This surgical procedure not only involves reducing and fixing the fracture, but must also take into account biomedical variables and the importance of soft bone tissue, not those relating to the skeleton. The main objective was to evaluate the rabbit as an animal model for surgical procedure involving osteosynthesis of the tibia and fibula, with reference to the findings reported in human and veterinary medicine in order to properly address the fractures caused by trauma. Material and methods: a lagomorph (*Oryctolagus cuniculus*) male 9 mo old, with a history of falls from 1 m height and grade IV claudication, was brought to the Small Animal Veterinary Hospital of the University of the State of Mexico. Fracture was confirmed by radiography and surgery was performed where intramedullary nails were inserted, tied in with an external fixator configuration type 1 candle 1-2 and acrylic rod. The post-surgical advances were recorded for 4 mo. Results: In previous work, osteosynthesis was established as a surgical procedure for reduction and fixation of the fracture, so it is necessary to carry out this research in an animal model such as the rabbit that has physiological characteristics similar to the human, considering not only the fixation of the fracture, but also medical variables and physiology of the soft tissues, as well as less invasive techniques. Conclusion: The similarities between animal models and humans are not limited to the bone structure in its basic mechanical properties, as in many cases the gross anatomy has many parallels. The rabbit is an excellent animal model for studies that help evaluate techniques and implants in fractures caused by high energy trauma in the tibial region, as in the field of medical surgery procedures that can implement complicated microsurgical techniques are required.

A CASE OF A TRICHOBLASTOMA ON A DOMESTIC RABBIT

NETRI C.*, UNZAGA M.F.*, ORIGLIA J.*, PISCOPO M.*, MARTINO P.†

*Cátedra de Enfermedades de Las Aves y los Pilíferos, Facultad de Cs. Veterinarias, Universidad Nacional de La Plata, CC 296, 1900 LA PLATA, Argentina. †Cátedra de Microbiología-CIC, Facultad de Cs. Veterinarias, Universidad Nacional de La Plata, CC 296, 1900 LA PLATA, Argentina.

pemartino@fcv.unlp.edu.ar

A case of skin basal cell tumour or trichoblastoma was diagnosed on a domestic 4-yr-old, male black dwarf rabbit (*Oryctolagus cuniculus*) based on morphologic and microscopic results. The animal was brought to the Veterinary College by its owner due to the sudden appearance of a greyish nodular subcutaneous mass measuring 3.0×2.0 cm and located on left tarsal zone in March 2014. Although basal cell tumours are common in cats and dogs, they are rare in all other domestic animal and, in fact, few reports have been published on cutaneous neoplasms in pet rabbits. Herein, a fine-needle aspiration cytology and histopathology were performed on the ulcerated mass, which was immediately fixed in 10% neutral buffered formalin, embedded in paraffin, sectioned at a thickness of 6 mm and stained with haematoxylin and eosin (H&E). Needle aspiration showed a population of basophilic epithelial cells with medium vesicular nuclei that exhibited morphology reminiscent of the progenitor cells of the epidermis and adnexa, along with no evidence of atypia. Histological examination revealed an encapsulated, nodular, subcutaneous mass of tumoural nests of basophilic isomorphic cells separated by interlaced trabeculae of connective tissue stroma and basal membrane structures of heavy eosinophilic stain, which led to a diagnosis of monomorphic basal cell tumour of solid type or trichoblastoma. Replicate serial sections from the paraffin-embedded tissue blocks were eventually prepared for immunostaining. The typical lesion for a trichoblastoma with regard to anatomic location, macroscopic and microscopic features concurred with those described in the literature. After surgical excision, the animal remains healthy. The aim of this study was to enrich the pathological aspects of this little described neoplasm in rabbits.

FUNGAL ZONOSIS IN A RABBIT FARM

REYNALDI F.J.*†, DELLA-VEDOVA R.*, ROSA D.E.*, TRIGO M.S.#, MARTINO P.†, CORDIOLIA C.A.#

*Cátedra de Micología Médica e Industrial. FCV. UNLP. Calle 60 y 119. LA PLATA. Argentina. †CCT-CONICET. Calle 60 y 119. LA PLATA, Argentina. #Comisión de Investigaciones Científicas. 60 y 119. LA PLATA. Argentina. #Cátedra de Introducción a la Producción Animal. FCAyF. UNLP. Calle 60 y 119. LA PLATA. Argentina.

cordiolac@argentina.com

Rabbit Ringworm is now the most widespread disease in industrial and family farms in Argentina and can cause greatest economic losses on rabbit farms. This ringworm

could be settled in many hatcheries since their foundation and there may also be tools, crates or other materials contaminated by animals, with traces of hair with fungi spores. Typical symptoms of ringworm are flakes on the face, hands, ears, and less frequently on the rest of the body. The affected area shows up red or pink with a thin crust on the skin. Objective: to determine the presence of Dermatophytosis in a farm of the Province of Buenos Aires. To this end, we checked the infrastructure, hygiene and health status of the animals, and also took samples from ringworm affected rabbits, personal injury compatible with ringworm, hens with areas of alopecia which shared the same line of cages for development and environmental samples. Samples from animals and humans were obtained by removal and/or scraping of hair, or feathers in the case of hens. Direct microscopic observation using 40% KOH and cultured on Sabouraud agar with chloramphenicol and cycloheximide was carried out for these samples. For food, bed and environment, we used the hook technique (plates with sterile dirt and hairs were inoculated with samples). They were incubated at 25/28°C between 7 and 21 d. Positive cultures were identified by macro and micromorphology and physiological tests (urea and hair *in vitro*). Samples from rabbits, humans, and environment were positive to direct examination and *Trichophyton mentagrophytes* was also isolated in all cases. In addition, samples of hens were negative on direct examination, but *T. mentagrophytes* was isolated. These results show the potential for spreading of this zoonotic. Moreover, the etiologic agent was detected in environmental samples, the staff that took care of the rabbits and the rabbits and hens that shared the room. The importance of this situation in society must be emphasised, as this farm was selling rabbits and chickens to people and could spread zoonosis. We highlight sanitary control as a tool to avoid the spread of this zoonosis.

WEIGHT GAIN EVALUATION OF RABBITS (*ORYCTOLAGUS CUNICULUS*) MEANT FOR HUMAN CONSUMPTION USING TWO GROWTH PROMOTERS

RODRÍGUEZ-CORREA J.L.[†], VALLADARES-CARRANZA B.*, VELÁZQUEZ-ORDÓÑEZ V.*, ALONSO-FRESÁN M.U., DE JESÚS A.P.*, DOMÍNGUEZ-VARA I.A.[‡], MARIEZCURRENA-BERASAIN M.A.[‡]

*Facultad de Medicina Veterinaria y Zootecnia. Universidad Autónoma del Estado de México Cuerpo Académico en Salud Animal (UAEM-CA-3 Salud Animal). [†]Programa de Ciencias Agropecuarias y Recursos Naturales – UAEM. Área Salud Animal. Centro de Investigación y Estudios Avanzados en Salud Animal. Km 15.5, carretera Toluca-Atlacomulco, Estado de México. [‡]Departamento de producción animal FMVZ-UAEM. Cuerpo Académico en Producción Animal.

benvac2004@yahoo.com.mx

Increasing demand for food has encouraged the use of additives in animal meat production. In animals meant for feeding, growth promoters not only contribute to the increase in total weight gain but also to food conversion. Nandrolone laurate (NL) and clenbuterol clorhydrate (CBL), which have been used in animal meat production, are subject to health and safety restrictions. The aim of the study was to evaluate the effect of NL in productive parameters of rabbits meant for human consumption, in which total weight gain (TWG) and food conversion (FC) were measured. Fifteen hybrid, male and female rabbits were used, divided into 2 treatment groups (n=5 each): T1 (0.20 µg/kg NL intramuscularly (IM) administered every 20 d); T2 (16 µg/kg/d CBL orally administered in drinking water); and a control group (CG) which received 1 mL IM saline solution as placebo every 15 d. Rabbits were observed for 30 d, in which food and water was given *ad libitum*. Results were analysed using variance analysis ($P<0.05$). TWG and FC according to the treatments were: T1 1.535 kg and 9.94; T2 1.335 kg and 10.72 and for CG 1.188 kg and 13.40 respectively. The use of NL and LDN as promoters showed a slight effect on daily and total weight gain, with contraindication for rabbit production, affecting not only profitability but also food safety.

PHYSIOPATHOLOGY DUE TO COPPER INCREASE IN RABBIT DIETS (*ORYCTOLAGUS CUNICULUS*)

CASTRO G.J.*, REYES A.J.F.*, VALLADARES C.B.*, LEE J.L.[†], TREMARI T.R.M.[†], ALONSO F.M.U.*[‡], VELÁZQUEZ O.V.*[‡], ORTEGA S.C.*[‡], BARBABOSA P.A.*

*Centro de Investigación y Estudios Avanzados en Salud Animal. Facultad de Medicina Veterinaria y Zootecnia. UAEM. Km 15.5 Carretera Toluca-Atlacomulco, Toluca, Estado de México, C.P. 50200, México. [†]Servicio Geológico Mexicano, Centro Experimental de Oaxaca, Desviación a San Lorenzo Cacaotepec S/N, SAN PABLO ETLA, Oaxaca. C.P. 68258.

muaf@uaemex.mx

Copper is an enzymatic cofactor, essential for Fe usage, connective tissue formation, pigmentation and energy production. The objective of this study was to analyse the physiopathology of renal and hepatic damage in rabbits fed alfalfa with high copper content from a rabbit farm in the State of Mexico, from which 20 rabbits were sampled, taking blood from the auricular vein 4 mL with and without anticoagulant at different periods to evaluate physiological parameters: haematocrit, total proteins, ALT (alanine aminotransferase), AST (aspartate transferase), GGT (gamma glutamyl transferase), urea and creatinine. The first samples were taken when the rabbits were aged 8 wk, and then 15, 30, 45 and 60 d afterwards. Each sample was centrifuged and divided for analysis in the laboratory, comparing the results with reference values. Initial haematocrit found was 43 ± 2.50 and $37 \pm 14.57\%$ at

60 d; total protein concentration started in 7.2 ± 0.49 and decreased to 5.83 ± 0.15 g/dL 45 d thereafter. Initial ALT levels were 48 ± 13.89 UL, increasing to a final level of 64 ± 4.16 UL; average GGT levels were 10 ± 2 UL. AST levels on day 45 were 33 ± 4.73 , increasing to 51 ± 23.12 UL on day 60; urea increased from 0.3 ± 0.10 mmol/L up to 27 ± 1.65 mmol/L on day 60. Creatinine levels were 90.18 ± 6.47 μ mol/L increasing up to 121 ± 6.53 μ mol/L in the last period. The parameters obtained show that rabbits exposed to copper suffer physiological changes which alter erythrocyte, renal and hepatic physiology.

MEAT QUALITY & SAFETY

CHANGES IN COLLAGEN IN CALIFORNIA RABBIT BREEDS AFTER SLAUGHTER

ALVARADO C.G.A.*, LLORENTE B.A.*, MONTIEL S.J.F.†, ALQUICIRA P.E.‡

*Laboratorio 7 Bioconservación; †Laboratorio 8 Biotecnología Alimentaria, Unidad de Investigación Multidisciplinaria, Facultad de Estudios Superiores Cuautitlán campus 4. Universidad Nacional Autónoma de México. km 2.5 carretera Cuautitlán-Teoloyucan, Col. San Sebastián Xhala, CUAUTITLÁN IZCALLI, Estado de México 54714, México. ‡División de Ciencias Básicas, Universidad Autónoma Metropolitana. Av. San Rafael Atlixco No 186, Iztapalapa, Vicentina, MÉXICO D.F. 09340, México.

llorente@unam.mx

The aim of this research is to characterise the changes that occur in collagen of rabbit after slaughter of the rabbit to 96 h later. The methodology used included the extraction and quantification of total collagen and its fractions (soluble and insoluble) from *Quadriceps femoris* muscle of 30 California breed rabbits 70 ± 3 d old, as well as obtaining the electrophoretic profiles of fractions and collagen fibres, under denaturing or reducing conditions. The pH in the *Quadriceps femoris* muscle at baseline was 6.64 ± 0.07 and during the first 24 h fell to 5.57 ± 0.10 and after 48 h to 5.48 ± 0.12 . After 72 h and 96 h, the pH value increased by 5.873 ± 0.0437 and 5.924 ± 0.1315 , respectively. *Quadriceps femoris* muscle on average presented 2.24 ± 0.245 mg collagen total/g, insoluble collagen 1.84 ± 0.186 mg/g and soluble collagen 0.34 ± 0.072 mg/g. According to the behaviour of these fractions regarding time, we observed that the collagen total was not statistically different, while the soluble and insoluble fractions were statistically different ($P < 0.05$) mainly in *post-mortem* at 96 h. The changes observed by electrophoresis in collagen fractions, according to the results obtained in this experiment, may be related to the enzymatic activity of metalloproteinases and collagenases as well as changes in pH, in agreement with previous

reports in the literature. The amount of soluble collagen is related to the kinetics of pH at 96 h *post-mortem*. The pH was near 6 and the highest amount of soluble collagen was obtained. The collagen fibres and soluble and insoluble fractions obtained under denaturing and reducing conditions showed an electrophoretic profile characteristic of subunits α_1 , α_2 , β_{11} , β_{12} of collagen. To determine the concentration of collagen, subunits over $10 \mu\text{g}/\mu\text{L}$ were distributed between the γ subunit and the high molecular mass polymers. The use of reducing agent in the electrophoresis confirmed the presence of type III collagen. Methodologies for extraction of collagen fibres and their soluble and insoluble fractions affect the sensitivity of the results, despite uniformity in the methods used for quantification of total collagen and its fractions. The highest percentage of soluble collagen was obtained at 96 h *post-mortem*.

EFFECT OF ENRICHED DIETS ON FAT COMPOSITION, SENSORY CHARACTERISTICS AND NUTRITIONAL VALUE OF RABBIT MEAT

CAPRA G.*, MARTÍNEZ R.†, COZZANO S.†, MÁRQUEZ R.‡

*Instituto Nacional de Investigación Agropecuaria (INIA). Estación Experimental INIA Las Brujas. Ruta 48, km 10, Rincón del Colorado, CANELONES CP 90200, Uruguay. †Universidad Católica del Uruguay (UCU) Av. 8 de Octubre 2738. CP 11600, MONTEVIDEO, Uruguay. ‡Laboratorio Tecnológico del Uruguay (LATU). Av. Italia 6201. CP 11400, MONTEVIDEO, Uruguay.

gcapra@inia.org.uy

The aim of this study was to evaluate the effect of modifying the diet of rabbits on their intramuscular fat composition through the addition of different oils (high oleic sunflower, fish), oilseeds (flax, chia and canola) and synthetic conjugated linoleic acid (CLA). The experiment involved eight treatments with a control (T1) consisting of the supply of commercial pelleted food *ad libitum* plus fresh alfalfa *ad libitum*. All the other treatments used the same diet with the addition to the pelleted food of 8% canola seed and 2% fish oil (T2); 8% canola seed (T3), 2% fish oil (T4), 8% canola, 2% fish oil and synthetic CLA (T5), 6% flax seed (T6), 2% high oleic sunflower oil (T7) and 6% chia seed (T8). 160 V line rabbits with an average weight of 1145 g were randomly distributed to the different treatments. Each treatment included 5 cages containing 4 individuals each (2 males and 2 females). The rabbits were weighed weekly until they reached 2500 g, when they were slaughtered. *Longissimus lumborum* samples of 5 animals from each treatment were analysed for intramuscular fat content and composition. Some fatty acids rates were calculated to assess the fat nutritional value: polyunsaturated/saturated, saturated/(monounsaturated+polyunsaturated), n6/n3 and the atherogenicity and thrombogenicity indices. The addition of the evaluated

ingredients showed modifications in the intramuscular fat composition when compared to the control (T1). The possibility of improving the nutritional quality of rabbit meat through diet modifications with the goal of enriching meat contents in n-3 fatty acids, oleic acid and/or conjugated linoleic acid was confirmed. Fat composition differences between treatments also established effects on the indices used to estimate the nutritional value. The sensory evaluation showed a negative influence of the fish oil on meat smell, taste and overall liking.

EFFECT OF GENETIC LINE ON CARCASS FEATURES IN NEW ZEALAND VS. CALIFORNIA RABBITS.

SÁNCHEZ A.P.*, FLORES P.C.S.†, MERCADO M.C.‡, MORA V.J.M.*, CORTES A.J.L.‡

*Facultad de Medicina Veterinaria y Zootecnia, Bioterio del Hospital Veterinario para pequeñas especies, Universidad Autónoma del Estado de México- UAEMex. México. †Facultad de Estudios Superiores Cuautitlán, Departamento Ciencias Pecuarias, UNAM. México. ‡Facultad de Estudios Superiores Cuautitlán, Departamento Ciencias Pecuarias, Unidad de Aislamiento y Bioterio. UNAM. México. *Facultad de Medicina Veterinaria y Zootecnia. UNAM., México.

pedrosanchezaparicio0@gmail.com

Rabbit is probably the domestic mammal with the highest production potential for meat supplies, as the flesh is lean with a high percentage of polyunsaturated oils. The meat composition varies according to age of the animal and the feed system. However, the effect of breed on the morphometry and carcass yield in adult rabbits has not been assessed. So, the purpose of this study was to evaluate the effect of breed on morphometry, carcass yield and meat-fat-bone ratio in New Zealand vs. California rabbits. The experiment was performed in the meat workshop of the Central Teaching Faculty of Cuautitlán, UNAM. 30 New Zealand breed rabbits and 30 California breed were used; the rabbits were slaughtered upon reaching 77 d. For the experiment, we recorded the slaughter weight, hot carcass weight and cold carcass weight of the rabbits of the 2 respective breeds: 15-18 h post-slaughter and refrigerated at 2±2°C. The rabbits were desensitised, disjointed cervically and then sacrificed by exsanguination according to NOM-033-ZOO-1995. After slaughter, the rabbits were deboned manually and the carcasses were evaluated separately; meat, bone and fat were weighed and the values recorded. Findings from the experiment indicate that the rabbits from the New Zealand line have better carcass weight hot and cold when compared with the California breed. The commercial performance in this genetic line also happens to be greater, with the interesting feature that the thoracic region is the site where most meat is deposited.

CONTRIBUTION TO THE SAFETY OF MEAT RABBIT WITH THE DETECTION OF AFLATOXIN B1 IN BALANCED FOOD FOR RABBITS

GARCÍA-SEGURA F., VILLARREAL ESPINO-BARROS O.A., HERNÁNDEZ-HERNÁNDEZ J., BECERRA-CASTRO E.

Facultad de Medicina Veterinaria y Zootecnia, Benemérita Universidad Autónoma de Puebla. México.

sersocialflorencia@hotmail.com

The aim of this project was to detect the B1 Aflatoxin in balanced food for rabbits distributed by different commercial brands, using fine layer chromatography as research method, with the use of acetonitrile to obtain the substratum of the food. Once the plate was prepared, it was immersed in a mixture of 98 mL of Tetrachloride of Carbon (CHCl₃)+2 mL of Methanol (Ac2O). This was done by the ascending method, which allows the thinner to ascend the plate almost vertically by capillary action. The plate was revealed by an ultraviolet light lamp at an excitation wave of 254 nm. Observing the plate and the results obtained in the first 6 points, the B1 aflatoxin appeared as they were exposed to different concentrations of B1 aflatoxin, which served as standards for identification, and in the last three points that correspond to our samples there was no B1 aflatoxin. Therefore, our results were negative for B1 aflatoxin in the 3 different commercial brands of balanced rabbit feed that were analysed.

MEAT QUALITY OF RABBITS FED FEATHER MEAL

TRIGO M.S.*†, BORRÁS M.M.*, CORDIVIOLA C.A.* , ANTONINI A.G.*†, CUMINI M.L.‡, COSSU M.E.‡

*Curso de Introducción a la Producción Animal, Facultad de Ciencias Agrarias y Forestales, UNLP. 60 y 119, LA PLATA, Argentina. †IGEVEF, Facultad de Ciencias Veterinarias, UNLP. 60 y 118, LA PLATA, Argentina. ‡Dpto. de Producción Animal, Facultad de Agronomía, UBA. Av. San Martín 4453, BUENOS AIRES. Argentina.

mstrigo@agro.unlp.edu.ar

The aim of this work was to evaluate the effect of an alternative protein source (feather meal instead of meat meal) and the inclusion levels (170 and 140 g crude protein) on meat quality traits in rabbits. The trial was conducted in the Faculty of Agricultural and Forestry Sciences, National University of La Plata, Argentina. Forty New Zealand×Californian rabbits, weaned at 28 d of age, were used. Animals were randomly distributed into individual cages. The experimental design was a 2×2 factorial: 2 sources of animal protein (meat meal [MM] as the control diet and hydrolysed feather meal [FM]) and 2 levels of crude protein (17 and 14% as 'control' and alternative lower protein requirement in the finishing period). All diets had equal energy content (dry energy= 2500 kcal/kg). Food was supplied *ad libitum*. At 75 d of

age, the rabbits were slaughtered, following the standard procedures of rabbit slaughter and carcass dissection by Blasco and Ouhayoun (1996); the weight of the hot carcass (30 min post-mortem) was determined. On the *Longissimus* muscle of refrigerated carcasses (24 h post-slaughter, $4\pm 1^\circ\text{C}$), the pH value (pH-meter Hanna, Ingold 406 M3) and Colour (L^* , a^* , b^* ; CR-300 Minolta Chromameter) were measured; the Chroma was calculated as $C = \sqrt{(a^*)^2 + (b^*)^2}$. Left *Longissimus* muscle weight (% cold carcass), cooking losses (water bath, 50 min at 70°C), hardness (Warner-Bratzler on Instron 1114), were determined. Collected data were analysed by ANOVA using the GLM procedure of SAS (2004) for a factorial model (sources and levels of protein and their interaction). Mean differences between treatments were compared using the Tukey test ($P < 0.05$). The protein level of diet significantly influenced slaughter weight, % hot carcass, parameters a^* , b^* and C^* , and cooking losses. The protein source of diet had less influence and only affected the meat/bone ratio. In conclusion, the protein level was significant in the development of the rabbits, while the inclusion of hydrolysed feather meal did not affect the meat performance traits. Therefore, the inclusion of feather meal in rabbit finishing diets is conditioned by the cost and availability of this by-product.

DIFFERENT TIMES OF SUPPLYING A DIET RICH IN FISH OIL IN FATTENING RABBITS AND ITS IMPLICATION ON MEAT QUALITY

LAMANNA M.L., COSSU M.E., PICALLO A., GAMBETTI P., TORASSO P.

Departamento de Producción Animal, Facultad de Agronomía, Universidad de Buenos Aires. Av. San Martín 4453. CABA. BUENOS AIRES. Argentina.

lamanna@agro.uba.ar

Changes in the lipid profile of rabbit meat may be achieved through dietary changes. Different strategies are used to achieve an improvement in the content of omega 3 fatty acids and the omega-6/3 ratio (use of flax, chia, fish oil), modifying the physical, chemical and sensory quality. The aim of this study was to evaluate sensory and physical quality of rabbit loin using different periods of supplying a diet with fish oil to modify the lipid profile. Thirty rabbits (New Zealand×Californian, 45 d age) were bred for 30 d (10 animals/treatment). Two diets were used, commercial feed and the same diet with addition of fish oil (1.8%). Treatments were: control (C) commercial feed; initial fish (IF), fish oil diet provided from 45 to 60 d of age+C diet from 60 to 75 d of age, and final fish treatment (FF) conversely to the previous one. After slaughter (24 h), loin muscles were used to determine pH (Testo230), colour (CIELAB system, MinoltaCR300) and fatty acid composition.

Loins were cooked in a double contact grill ($71^\circ\text{C}\pm 1^\circ\text{C}$ in the centre of the sample). Samples were analysed by an analytical panel of 8 trained assessors. The following descriptors were evaluated: overall colour; intensity and typicality of odour/flavour; fat taste and juiciness, using an unstructured linear scale of 10 cm. Statistical analysis was performed using the Proc Mixed of SAS (2004) for univariate ANOVA. Differences between treatments were analysed by Tukey test ($P < 0.05$). No differences were found for productive parameters, slaughter weight and carcass yield (%), nor pH and colour parameters ($P > 0.05$). Sensory results were similar for colour, odour, off-odour and characteristic odour, but smell-taste variables like characteristic flavour and off-flavour were influenced by diets. Control diet had higher 'rabbit flavour', followed by IF but they were not different on the off-flavour parameter ($P > 0.05$). FF had more off-flavour and less characteristic flavour. Treatments with fish oil (IF and FF) had a lower ratio n6/n3 with higher content of EPA and DHA than control. The early assignation of fish diet improved the n6/n3 ratio without negative effects on the sensory and physical meat quality, or the productive parameters.

SENSORY MEAT QUALITY: INFLUENCE OF DIET SUPPLEMENTED WITH OIL AND ANTIOXIDANTS IN FATTENING RABBITS

LAMANNA M.L., COSSU M.E., PICALLO A., GAMBETTI P., CUMINI M.L., GRIGOLI M.C.

Departamento de Producción Animal, Facultad de Agronomía, Universidad de Buenos Aires. Av. San Martín 4453. BUENOS AIRES. Argentina.

lamanna@agro.uba.ar

As consumers become more aware of their diets and the impact on their health, there has been a shift to eating white meat for its lower fat content. Meat from rabbits fed commercial diets show a greater n6/n3 ratio than those of health recommendations ($n6/n3 < 5$); one way to improve the lipid quality is to add fish oil, rich in n-3FA, as these changes can affect consumer acceptability as nutrition, influencing the sensory quality of meat. The aim of this study was to compare the effect of adding fish oil and 2 types of antioxidants to fattening rabbit diets on sensory quality of loin and thigh meat. Eighty New Zealand×Californian rabbits were fed *ad libitum* (35-70 d) with 4 diets: 'C', commercial diet; fish diet (F) with addition of 1.8% of oil fish; vitamin diet (V) (F+200 ppm vitamin E as an industrial antioxidant) and algae diet (A) (9% dried algae as a natural antioxidant). After 24 h of slaughter (2.5 kg live weight; chilling chamber, $2\pm 0.5^\circ\text{C}$), loin and thigh portions were removed and cooked in a double contact grill ($71^\circ\text{C}\pm 1^\circ\text{C}$) after deboning. Samples were analysed by an analytical panel of 8 trained assessors for overall colour, intensity

and typicity of odour/flavour, fat taste and juiciness, using an unstructured linear scale of 10 cm, without anchorage (lower limit: 0; upper limit: 10). Statistical analysis of data was performed using the Proc Mixed (SAS, 2004). Differences among treatments were analysed by Tukey test ($P<0.05$). For both the loin and the thigh, only smell-taste variables such as the characteristic odour, off odour and off flavour were influenced by diets. Control diet had higher 'rabbit odour' and less off odour/flavour compared to diets with added fish oil ($P<0.05$). For both cuts of meat, between experimental diets, the presence of algae determined quantitatively higher values of off odour/flavour, but no differences in characteristic odour, while diets F and V were similar. In conclusion, the addition of fish oil and antioxidants to fattening rabbit diets provides meat with same colour, flavour, juiciness and unctuousity compared to a commercial diet, but more presence of off odour/flavour, being stronger in thigh than loin and especially for algae-based diet.

EFFECT OF DIETARY OIL FISH AND VITAMIN E ON THE FATTY ACID COMPOSITION AND MEAT QUALITY

LAMANNA M.L., COSSU M.E., GAMBETTI P., GRIGOLI M.C., IGLESIAS M.F.

Departamento de producción Animal, Facultad de Agronomía, Universidad de Buenos Aires. Av. San Martín 4453. BUENOS AIRES. Argentina.

lamanna@agro.uba.ar

The current search for food of high nutritional value is growing; consumers are aware of new products that help improve the healthy lifestyle. Nowadays, diets are unbalanced in fatty acid omega 6 and 3. One way of approaching the recommended ratio ($n6/n3<5$) is to include omega 3 fatty acid in animal feed. Particularly, the most bioactive compounds for human system are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), but the elongation capacity of linolenic fatty acid over 20 carbon polyunsaturated FA is limited. The aim of this work was to increase EPA and DHA in rabbit meat with a low $n6/n3$ ratio, according to health recommendations. Eighty growing rabbits (New Zealand×Californian) were fed *ad libitum* from 35 to 70 d of age, with 4 diets (20 animals/treatment); a commercial diet (C) and 3 diets with addition of 1.8% oil fish: 'fish' diet (F), 'vitamin' diet (V: F+200 ppm vit. E) and 'algae' diet (A: 10.0% dry *Macrocystis* algae). The final weight and carcass yield were determined at slaughter time (2.5 kg live weight). After of 24 h of slaughter, the measurements of pH (Testo 230), colour (CIELAB system, Minolta-CR300), lipid oxidation (TBARS) and fatty acids profile (by GC) were determined on the right loins. Statistical analysis was performed using the Proc Mixed by SAS (2004) for univariate ANOVA; differences

between treatments were analysed by Tukey test ($P<0.05$). The slaughter weight was heavier for the control and fish treatments ($P<0.05$) but no differences were found in carcass yields (mean 59.3%). The carcass traits, pH, colour and TBARS values did not differ significantly according to diets. The use of fish oil determined a lower $n6/n3$ ratio (4.5 for F, V and A) compared to the control diet (15.1), in accordance with the limits recommended for human consumption. Furthermore, higher content of EPA (mean 1.09%) and DHA were found in F, V and A (3.38, 3.37 and 4.54% total fatty acids, respectively). In conclusion, the use of fish oil addition in fattening diets of rabbits provides high content of n-3 in meat, particularly of EPA and DHA FA content, and lipid oxidation in fresh meat is not observed.

EFFECT OF BILBERRY AND ARTICHOKE CO-PRODUCT TREATMENTS ON GROUND RABBIT MEAT CHARACTERISTICS DURING REFRIGERATION STORAGE

DABBOU S.*[†], DABBOU S.*[†], ROTOLO L.[‡], GASCO L.[‡], GAI F.[‡], KOVITVADHI A.[‡], HELAL A.N.*

*Laboratory of Bioresources, Integrative Biology and Valorisation, Higher Institute of Biotechnology of Monastir, Av. Tahar Hadded, BP 74, 5000 MONASTIR, Tunisia. [†]Department of Agriculture, Forestry and Food Sciences, University of Turin, Largo P. Braccini 2, 10095 GRUGLIASCO, Torino, Italy. [‡]Institute of Science of Food Production, National Research Council, Largo P. Braccini 2, 10095 GRUGLIASCO, Torino, Italy.

sihem.dabbou@yahoo.fr

The use of synthetic antioxidants is one of the major strategies for preventing lipid oxidation problems in meat products. To extend the shelf life, current recommendations restrict synthetic food additives and encourage their replacement by naturally-occurring ingredients with similar functions. Hence, there is growing interest in natural antioxidants in meat products. In this context, the use of bilberry pomace (BP) and artichoke bracts (AB) by-product powders as sources of natural antioxidant in ground rabbit meat stored at 4°C for 12 d was evaluated. The following 7 treatments were tested: group 1-Control (rabbit meat without salt and natural antioxidant), group 2-S (2% w/w of salt), group 3-BHT (2% w/w of butylated hydroxytoluene), group 4-AB0.5 (2% w/w of salt and 0.5% w/w of AB), group 5- AB1 (2% w/w of salt and 1% w/w of AB), group 6-BP0.5 (2% w/w of salt and 0.5% w/w of BP) and group 7- BP1 (2% w/w of salt and 1% w/w of BP). The water and lipid content, pH value, lipid oxidation, total phenolic content and antioxidant activity were determined. Two-way ANOVA was performed to study the full factorial design (treatment and storage time). Results showed a significant interaction of storage time and antioxidant treatment on the water and lipid content of the studied

samples. Rabbit meats treated with AB and BP showed a decrease in their pH values during storage independently of the concentration. In addition, they showed higher phenolic levels and therefore a higher antioxidant activity. The oxidation process was significantly ($P < 0.05$) delayed by the type of antioxidant and its concentration. Therefore, it was concluded that AB and BP have the potential to be successfully used as natural antioxidants to minimise the lipid oxidation of rabbit meat stored at refrigerated temperature.

MANAGEMENT, SOCIAL & ECONOMY

IS BACKYARD RABBIT PRODUCTION A DEVELOPMENT OPTION FOR SMALLHOLDERS IN THE MEXICAN SOUTHEAST?

CRUZ-BACAB L.E., SANDOVAL C.C.A., AGUILAR C.A.J.

*Universidad Juárez Autónoma de Tabasco, División Académica de Ciencias Agropecuarias. Carretera Villahermosa-Teapa, km 25, R/A. La Huasteca 2ª Sección, CP 86280. VILLAHERMOSA, Tabasco, México. †Universidad Autónoma de Yucatán – Campus de Ciencias Biológicas y Agropecuarias. Carretera Mérida-Xmatkuil, km. 15.5, MÉRIDA, Yucatán, México.

lecb82@gmail.com

This paper reviews the characteristics of rural backyard production in the Mexican southeast as well as the opportunities to include rabbits as a productive animal in backyard production system. Animal husbandry as a production system has an important role in improving the quality of life of these rural communities. Backyard livestock production is an important activity for rural communities around the world, representing a constant source of food, income and savings, as well as providing social status within the community. In Mexico, at least 90% of rural families rely on this type of production activity, while in the Mexican southeast it is carried out by 60-85% of rural families. The Mexican southeast region is characterised by tropical conditions where wide varieties of plant species represent sustainable alternatives for animal production, especially herbivore species. Rabbit's ability to consume fodder and convert it into high quality protein products represents a potential alternative for traditional production systems in tropical areas maintaining a synergistic animal-crop combination. In conclusion, the conditions in southeast Mexico are suitable for the inclusion of rabbits as a production alternative for rural communities. The presence of a wide variety of plants and fibrous resources with potential for rabbit meat production would benefit south-eastern rural populations by improving nutrient intake. However, further research is needed to characterise rabbit utilisation and keeping with a view to developing

efficient strategies for its successful incorporation to rural backyards of the Mexican southeast.

RABBIT PRODUCTION IN COSTA RICA: BREAKING WITH TRADITION

BRENES S.A.

*Professor and Researcher. Área de Especies Alternativas, Escuela de Zootecnia, Universidad de Costa Rica, SAN JOSÉ, Costa Rica.

andrea.brenessoto@ucr.ac.cr

Rabbit production should be recognised as an activity with low environmental impact which can be associated to other production activities using agro industry residues and other agricultural by-products. Costa Rican rabbit meat production is carried out through small/medium-sized farms, but the absence of an efficient production chain causes producers to trade their products in informal markets. On the other hand, with this system, farmers can count on a better quality protein source and, at the same time, commercialise the surpluses in the markets and another part of the population, mainly urban, has access to this. Costa Rica decided to enter the international markets, exporting meat to some countries in Central, North and South America, as well as Asia, from 2003 to 2008, but important trade-related difficulties arose due to the falling demand in rabbits for exportation and an undeveloped domestic market. For this reason, the target market in Costa Rica then changed, in an attempt to enhance national consumption. At present, 20% of the total market belong to 2 big farms which sell meat to 2 large supermarket chains and keep farms with an average of 300 does and meat production of around 450 kg meat/month; 60% of farms have between 25 to 60 does, distributing the product through restaurants, hotels and retail, while the remaining 20% belongs to small systems with 5-10 does. Medium and small farmers can obtain 20-200 kg/month. Recently, a pressing demand from high cuisine and touristic industry called for market organisation and suggested production growth. Although there is no set national policy to stimulate rabbit production, the Rabbit Research Programme of the University of Costa Rica is working to improve the use of rabbit as a meat source, through projects in reproduction, carrying out andrologic studies in bucks, nutrition trials, tasting sessions and the use of manure as organic fertiliser, while also educating the consumers about the differences between rabbits for meat production and rabbits for keeping as pets. The aim is to overcome the current barriers, starting with marketing politics for the sector and product quality improvement in the market, with added information for cooking.

LIFE CYCLE ASSESSMENT FROM PRODUCTION OF ONE KILOGRAM OF RABBIT MEAT VS. CHICKEN

RAMÍREZ G.L.* , RAMÍREZ G.G.* , GÜERECA L.P.†

*Instituto Tecnológico y de Estudios Superiores de Monterrey Campus Ciudad de México. Calle del Puente, 222 Col. Ejidos de Huipulco, TLALPÁN C.P. 14380, México D.F. †Instituto de Ingeniería Universidad Nacional Autónoma de México. Circuito escolar s/n Ciudad Universitaria, Delegación Coyoacán. México D.F. CP 04510.

lizrubirg@gmail.com, geowitz99@gmail.com

Both rabbit and chicken are white meat and part of the Mexican diet. Today environmental concerns of consumers encourage companies to minimise the environmental impacts of their products. ISO 14040 describes the principles and framework for Life Cycle Assessment (LCA), which is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service. Therefore, we decided to use this methodology to analyse the supply chain of both meats. The functional unit considered is 1 kg of rabbit meat or 1 kg of chicken meat in order to provide a basis for the establishment of good practices by Mexican farmers. TRACI (Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts) software was used. The boundaries of the system analysed in the process were animal feeding, meat processing, consumption and waste disposal. The methodology consisted of compiling an inventory of energy and materials and evaluating the environmental impacts associated with each unit. Data measurements: faeces, urine, water and energy of machinery, were taken on the rabbit farm Los Tíos and the UNAM chicken farm. The life cycle impact categories analysed were eutrophication, global warming, use of fossil fuels, water use and land use as impacts from the production of 1 kg of chicken meat and rabbit. We conclude that chicken meat production requires larger amounts of energy and water. Machinery used to slaughter, freeze and clean assigned chicken meat a higher impact. Manure, especially from rabbits, causes eutrophication and land impact when it penetrates the soil and groundwater. Use of wastewater treatment plants, rainwater, low power cleaning machines, digesters and other technologies were suggested as ways to mitigate the environmental impacts of meat production.

COLLECTIVE ACTION STRATEGIES: PRODUCTION-COOPERATIVE “CONEJOS ANDINOS DE MENDOZA”

QUAGLIARIELLO S.G.

INTA EEA Mendoza. San Martín 3853. LUJÁN DE CUYO. Mendoza. Argentina.

quagliariello.gaby@inta.gob.ar

This work tackles the development of collective actions taken by Mendoza Rabbit Production-Cooperatives, associated with Rural Extension activities implemented

between 2002 and 2014 by INTA, the National Institute of Agricultural Technology in Mendoza. Collective action is the theoretical approach used in the project, which, among its various definitions, is considered as the ability of a group to manage common resources. Moreover, collective action is the result of interactions between the interests of the group and the individual strategies of the actors. Two types of collective action are recognised: the structural form, which only considers the existence of organisations, and the functional form, which considers the work of the organisations. The goals of this study are to identify and analyse the factors (internal as well as external) that promote and deter the development of collective action taken by the members of cooperative associations. The methodology is based on the handling of quantitative and qualitative data. The quantitative data was obtained from secondary sources, while the qualitative data came from semi-structured interviews conducted with several rabbit producers who are active at local level. Factors that mobilise collective action are associated with the trust ties arising from the economic and socio-cultural homogeneity of the actors, as well as their geographical proximity, the pursuit of technical knowledge and the genetic improvement by staff members, the need for marketing strategies and economic resources, and their interest in participating in governance processes. On the other hand, the factors which undermine collective action are connected to pluriactivity and the tensions built up in those processes meant to articulate their own interests to the interests of the group as well as the phenomena of disaggregation (conflicts, exclusion) that lead the organisation members to act individually. Although historical and contextual factors had a strong impact on the dynamics of the collective action prior to the formation of the ‘Conejos Andinos de Mendoza’ Production Cooperative, the capacity of these actors to organise around some common goals encouraged a process of collective learning and development of social capital connected to productive, technological and organisational issues.

THE CONTRIBUTION OF CHINESE RABBIT INDUSTRY AND ITS SUSTAINABLE DEVELOPMENT

Wu L.* , HUANG D.†

*Professor, College of Economics and Management, China Agricultural University. †Ph.D. Candidate, College of Economics and Management, China Agricultural University. No. 17, Qinghua East Road, Haidian District, BEIJING, 100083, China.

wulp@cau.edu.cn, huangdong@cau.edu.cn

Based on industry development theory and the Diamond model (Michael Porter, 1975), this paper studies the Chinese rabbit industry's development and contribution from the following perspectives - resource endowment,

market demand, related industry support, the strategy of rabbit farms and enterprises, so as to improve its sustainable development. The results show that the Chinese rabbit industry has strong advantages in terms of saving feed grain and creating more employment in its animal and husbandry industry, but the major constraints in the short run are from small scale production. In the long run, China needs to upgrade its rearing methods and enhance technical progress.