

ABSTRACTS OF 38TH SYMPOSIUM ON CUNICULTURE, ASESCU

ZAMORA, SPAIN, 30TH-31ST MAY, 2013.

The 38th Congress of the Spanish Association of Cuniculture (ASESCU) was held in Zamora from 30th to 31st of May 2013. This edition was mainly devoted to analysing the current situation of production costs in rabbit farming, processing of rabbit meat and new aspects in relation to rabbit diseases. The main papers were related to economic weights in rabbit meat production and production costs in terms of productivity, the cost of feed ingredients, new trends in rabbit meat processing, crossbreds in rabbit farming, hygiene on industrial rabbit farms, feed restriction and de-medicalisation and the new rabbit haemorrhagic disease, as well as the state of the knowledge on epizootic rabbit enteropathy. In addition, 2 round tables were held on the future of rabbit meat presentations and the unified market of Spain and Portugal for rabbit meat. Moreover, a total of 24 communications were presented, both in working sessions with oral communications and posters (pathology, technical-economical management, nutrition, meat and carcass quality and reproduction). The meeting was attended by more than 160 participants, including researchers from Spain, Portugal, Italy, France, Ecuador, Egypt, and Tunisia. The abstracts of the contributions presented are reported below.

MAIN PAPERS

ECONOMIC WEIGHTS IN RABBIT MEAT PRODUCTION

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We used a profit function based on a set of productive traits to estimate the profit, incomes and costs in a rabbitry with the most typical management techniques in Spain. The absolute, standardized and relative economic weights of several traits were also estimated. The estimated cost of production was 1.79 €/kg rabbit alive, the profit per doe and year was 1.69 € and the total profit of the rabbitry was 1267 €. Major costs were feeding fattening and labor (25.9 and 18.1% respectively over total cost). Once estimated the standardized economic weights the more important traits were feed conversion rate and number of kits born alive. The relative economic weight was 1.97 times greater for the feed conversion rate than for the number of kits born alive. Weaning and fattening survivals, daily feed intake, daily gain in fattening had little importance. The replacement rate had the lowest relative economic weight.

NEW TRENDS IN RABBIT MEAT PROCESSING

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Further processed products are currently demanded due to their convenience, high food safety and quality standards. However, even if processing industry is pushing more and more towards the introduction of more attractive products for consumers having few time for meal preparation, worldwide most rabbit meat is still sold as whole carcass or cut-up parts. This review will analyse the historical evolution of rabbit meat consumption and main force and weakness factors in relation to the use of rabbit meat to manufacture further processed products. Bearing in mind these considerations, it then describes the more promising technologies to process raw meat materials in order to obtain added-value products by exploiting rabbit meat intrinsic characteristics. Major trends in meat product formulation are also discussed by highlighting strategies to provide healthier meat products meeting current nutritional needs. Finally, main solutions in rabbit meat and meat products packaging are discussed.

PRODUCTION COSTS IN TERMS OF PRODUCTIVITY

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The aim of this paper is to show in a simple way the importance of productivity obtained from a rabbit farm in business profitability. Economic management allows us to assess the profitability of the activity, taking a very important role the control of production costs. In every business it should be clear how much it costs to produce the product or service. Whenever hard times arrive, the first need a farm manager is to optimize its resources adapting their production system to the situation to get the best results at the lowest cost, but this should be a key principle for any activity.

THE NEW RABBIT HAEMORRHAGIC DISEASE

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Since autumn 2011, outbreaks of atypical rabbit haemorrhagic disease (RHD) have been detected in Spain, which particularly affect the kits. With the support of INTERCUN we have investigated the etiology of these outbreaks which were found to be due to a RHDV "variant" showing relevant genetic and antigenic differences with respect to the classic virus. This paper summarizes the characterization of the new virus, the epizootic studies of this new disease in Spain, and preliminary data towards the development of a new vaccine with improved efficacy against variant RHDV.

FEED RESTRICTION AND MEDICATION DECREASED. JUSTIFICATION AND FIELD TRIALS

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Current production systems have led to an increase in the administration health products, significantly increasing the production costs. Two different food restriction systems in young rabbits are evaluated (PLC and time) as a method of reducing the administration of antibiotics in the feed-stuff and its influence on mortality and growth and average daily gain (ADG). The results with a restriction of antibiotics in the stuff were similar to *ad libitum* feeding and there were no significant differences on mortality and average daily gain (ADG) studied in both feeding systems.

PATHOLOGY

HOW RABBIT PRODUCERS VACCINE AGAINST MYXOMATOSIS AND VIRAL HAEMORRHAGIC DISEASE?

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In this study, we determined the use of vaccination schedules against myxomatosis and viral haemorrhagic disease (VHD), in young rabbit breeders, in adults or both. Data were gathered on 2049 visits to 264 conventional rabbitries in Spain, during January 2010-March 2013. The median size of the farms was 750 does (minimum to maximum: 102-9000 does). On 93.6% of the visited farms, rabbits were vaccinated against myxomatosis, and 95.1% against VHD. We describe also the use of vaccines elaborated with heterologous strains (Shope fibroma) or with homologous strains, besides their combinations with vaccines against VHD.

EXPERIMENTAL EVALUATION OF A NEW AUTOGENOUS VACCINE AGAINST STAPHYLOCOCCUS AUREUS IN RABBITS

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Staphylococcus aureus is associated with pododermatitis, mastitis and subcutaneous and internal abscesses in rabbits, which can lead to poor production results, infertility, agalactia and death. The aim of this pilot study was to experimentally evaluate and compare the results obtained with 2 autogenous vaccines against *S. aureus* with different antigenic composition using a rabbit intradermal infection model. Three groups of 7 rabbits were studied. Groups 1 and 2 were vaccinated twice subcutaneously with vaccines 1 and 2 respectively with an interval of 20 d, while group 3 was injected twice with PBS. Twenty days after, all animals were inoculated intradermally with 10^9 cfu of 2 strains of *S. aureus* (C1 and C2). One of the strains (C1) belonged to the most common genotype in rabbits and was used to prepare the evaluated vaccines. Animals and lesions caused by C1 and C2 were examined daily and 14 d after the infection all rabbits were euthanized, with the exception of 3 which died during the study, and skin and damaged organ samples were collected. All animals presented similar skin lesions within 24 h post-

inoculation in C1 and C2 inoculation points. Neither of the vaccines prevented the development of lesions in this infection model, but differences in the evolution of the lesions, the presence of pus in the inoculation points and the elimination of *S. aureus* from those points, were found between animals vaccinated with vaccine 2 (100% of the lesions improved and recovered, pus was absent in 50% of the inoculation points and *S. aureus* was not isolated from 70% of those points) and control group when infection was caused by the same strain (autogenous vaccine) and by a heterologous strain.

EFFECT OF GENETIC TYPE, DIETARY ENERGY SOURCE IN LACTATION AND ANTIBIOTICS USE ON GROWING RABBIT PERFORMANCE

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A total of 2904 weaned rabbits at 30 d were used to study the effect of 3 genetic types (TC, founded for hyper-prolificacy at birth; Rob, founded for reproductive longevity, characterized by high robustness; and VC, selected for growth rate) on performance and sanitary risk (mortality and morbidity) during the growing period (30-58 d). Animals from VC type had higher feed intake and especially daily weight gain (on av. +19 and 29%, respectively; $P < 0.05$) than those from TC and Rob types, which supposed a better feed conversion ratio for VC rabbits (on av. -9%; $P < 0.001$). Animals from Rob type had lower mortality (9.5 vs. 19.0 and 16.5%, respectively; $P < 0.05$) and morbidity (3.9 vs. 6.6 and 9.9%, respectively; $P < 0.05$) than those from TC and VC types. When feed was medicated, animals from TC type presented the highest mortality percentages ($P < 0.05$), while VC type were the highest when no-medicated feed was used ($P < 0.05$). In conclusion, growing rabbits from a line characterized for a highest robustness has lower sanitary risk than those coming from lines founded or selected for productive criteria.

STUDY OF BLOOD LYMPHOCYTE POPULATIONS IN YOUNG RABBITS FROM DIFFERENT GENETIC TYPES

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It has been reported that different genetic rabbit lines show differences in their leukocyte populations that can be related with the use of selection programs. However, studies on leukocyte populations using flow cytometry are scarce. The aim of this study was to characterize and to compare blood lymphocyte populations in young rabbits from different genetic types, at the time of weaning (30 d), after 1st partum. The counting and differentiation of the leukocyte populations was performed by flow cytometry on peripheral blood. Lymphocyte subpopulations (B, TCD5⁺, TCD4⁺, TCD8⁺ and TCD25⁺), monocytes and granulocytes were identified using specific antibodies. Moreover, the correlation between TCD25⁺ lymphocyte counts and the health status of these animals was studied, concluding that the higher the TCD25⁺ count, the greater mortality rate.

IMMUNOPATHOLOGIC CHARACTERIZATION OF EXPERIMENTALLY INDUCED MASTITIS BY STAPHYLOCOCCUS AUREUS

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Staphylococcal mastitis is one of the main causes of culling of adult does from commercial rabbitries. It has been reported that these lesions can be caused by "high" or "low" virulence strains. Clinically, these 2 types of strains have shown differences regarding morbidity and mortality rates. Previous studies from our group revealed the existence of clones widely distributed and genetically adapted to cause infections in rabbits. The most widely-distributed genotype belongs to a clone designated as ST121. Similarly, there is a less distributed clone, designated as ST96. Hence, an experiment was designed in order to characterize the immune response developed by the animal after an experimentally induced mastitis using 2 strains from different clonal origin (ST121 and ST96). One hundred per cent of the animals inoculated with the strain ST121 developed evident lesions, while the animals infected with the strain ST96 did not show any signs of mastitis at the end of the study. These results were consistent with the variations observed in the populations of leukocytes analysed by flow cytometry. They showed

that the granulocytes and the monocytes from rabbit does inoculated with ST121 increased over the post-infection week, while T lymphocytes underwent a progressive decrease during this period, mainly due to the decrease of lymphocyte subpopulation T CD8⁺. However, none of these oscillations in leukocyte subpopulations were observed in rabbits infected with strains from ST96. These results confirm that the genetic characteristics of the bacterium, as well as the status of the immune system of the host, may be important for the development of staphylococcal lesions.

OCCURRENCE OF ENDOPARASITIC INFECTION IN PORTUGUESE RABBIT FARMS

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An epidemiological study was carried out between January of 2007 and April of 2011 in 41 Portuguese rabbit farms to investigate farm characteristics related with endoparasitic infections. *Eimeria* was diagnosed in 5 (12.2%) farms, of which 4 were from the north. Three farms had over 900 positive females. *Passalurus ambiguus* was isolated in 3 farms (7.3%), all with fewer than 900 females, 2 of which were located in northern Portugal. In one farm *Eimeria* and *Passalurus* were both diagnosed. *Encephalitozoon cuniculi* was diagnosed in 3 farms, all located to the north, and all had 900 females. In 1 farm *Encephalitozoon cuniculi* and *Passalurus* both diagnosed. These results demonstrate that the presence of coccidiosis and parasitic helminths must be continually supervised to implement appropriate measures on the farm to reduce infection.

TECHNICO-ECONOMIC MANAGEMENT

ANALYSIS OF SEVERAL PRODUCTIVE STRATEGIES IN A CONTEXT OF ECONOMIC CRISIS OF THE RABBIT SECTOR. ABILITY TO REACT TO VOLATILE MARKETS

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The economic situation of rabbit breeding sector was analyzed by using the information reported by different

Spanish management programs (FACC, bdCuni, Cogal). Results indicate that most of the farms have a negative NPV, while farms with better technical indexes reach a positive NPV. A simulation was performed in order to evaluate 3 strategies to minimize the economical losses: i) an increase in the efficiency of production; ii) a change to a more extended reproductive rhythm; and iii) the reduction of the amount of does in the farm. The values of the economical parameters required for the simulation were mean values in 2013: market price 1.85 €/kg of live rabbit and 0.30 €/kg of rabbit feed. The measure of economic performance is based on cash flow. The calculation of the iso-profit curves (NPV) shows that, under the present conditions, a production of 15 to 16 kg per artificial insemination (AI) is required in order to have positive returns. An extended reproduction rhythm worsens the balance when it is not accompanied by technical improvements to offset the loss of production associated with the lowest number of annual births. Thus, performing AI at 32 d *post-partum* results in a loss of 33% of production, a 33% of increase in the production costs and a decline in IOFC margin of 34%, with regard to results when AI is performed 11 d *post-partum*. The overcrowding associated with a more extended the reproductive rhythm worsens even more the balance. Reducing the number of does reduces fixed costs of salaried staff and it is a better strategy than the implementation of an extended reproductive rhythm. However, the only strategy leading to positive economical results is the improvement of productive and technical indexes.

FOLLOW-UP FOCCON STRATEGY FOR THE RABBIT SECTOR ATTACHMENT IN THE COMMON AGRICULTURAL POLICY. AN OBSTACLE COURSE

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This paper describes the follow-up of the strategy set up by FOCCON to attach the rabbit sector in the Common Agricultural policy (hereinafter CAP) post 2013, as this sector has historically been outside that agricultural policy and thus absent from the benefits enjoyed by virtually all other agricultural and livestock sectors. It analyzes the value chain, production, processing, consumption and self-sufficiency to support the demands presented and as well the process of submitting proposals, support actions (lobbying), coordination with relevant agencies, parliamentary procedure and co-decision process between Parliament and Council.

TECHNICAL MANAGEMENT RESULTS AND MARKET PRICE EVOLUTION IN RABBIT PRODUCTION

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Technical management indicators and constant prices evolution and relations in rabbit meat production in Spain from 2009 to 2012 are presented. In 2012, rabbitries had 80.5 and 75.8% of positive palpations and kidlings with respect to females. Mortality during lactation and fattening were 12.2 and 10.1%. The number of born alive, weaned, produced and kg produced per insemination were 7.5, 6.5, 5.9 and 12.4, respectively, and the mean liveweight at slaughter was 2.073 kg. The barley, diesel and feed prices increased 72.7, 39.2 and 26.7%, while the kg of rabbit alive and final price paid by the consumers decreased 1.6 and 14.2%. There was a positive correlation between the barley, diesel and feed prices (between 0.78 and 0.89). These products were not correlated to the price paid by the slaughterhouse to the farmer per kg of rabbit alive, but they presented negative correlations with the final price paid by the consumers. There was not correlation between the price paid to the farmer and the price paid by the consumers. These results suggested that the increase of the costs of some raw materials used in rabbit production were not finally reflected in the incomes of the farmers.

ASSESSMENT OF FARM EFFICIENCY THROUGHOUT A RABBIT DOES PRODUCTIVITY INDEX

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To face the problem of selection in small rabbit keeping units that cannot use industrial hybrids, a simple global selection index was developed in the 1980's. This index, named Annual Productivity Index (IPa, according to the Italian language), is calculated as $IPa = \frac{\sum d}{T} \times 365$, where: IPa is the estimation of the annual productivity of each doe, $\sum d$ is the sum of kits weaned until any weaning, and T is the number of days between the 1st mating and the considered weaning. In order to evaluate sampling strategies that permit estimating the value of the IPa, an analysis was performed using the 591 doe cards of an industrial farm in Viterbo (Italy). Mean IPa value of the farm

was 48.5 weaned rabbits/doe per year. The IPa values rose sharply for does from the 1st weaning, but increased more slowly for does from the 3rd to the last weaning. Value of the IPa for does at 5th weaning coincided with the mean IPa of the farm. A stratified sampling by weaning orders allowed estimating mean IPa of the entire breeding herd with errors of 5 and 10%, for a confidence level of 95%, from samples consisting of approximately 50 and 25%, respectively, of the breeding herd. In practice, if the available number of records at the 5th weaning were not enough, it could be used the IPa value at fourth weaning by adding 2.5, or that of the 3rd weaning by adding 4.0. In conclusion, the IPa is confirmed as a useful tool to easily and quickly measure the overall productivity level of a farm.

CHARACTERISATION OF INTERNET MARKETING OF WILD RABBIT COMMERCIAL GAME FARMS IN SPAIN

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An analysis, as marketing tool, of the websites of the commercial wild rabbit game farms in Spain was carried out. Sixteen web sites were found, representing only 6.3% of the registered farms. An 87.5% is reachable in a search with Google by using specific keywords. A 43.8% are included in relevant hunting portals. They provide sufficient information to identify, contact and access to the farm, but only half reflect the corporate identity of the company. Half of the websites do not allow deducing the breeding system of rabbits (in cages or in pens). Only 6.3% of the websites indicate the subspecies of rabbit raised. Half of websites report that the farm supplies vaccinated rabbits. Only 18.8% of the websites report the price of wild rabbits. A quarter of websites specify the geographic area in which the farm distributes its production, and 56.3% offer customer transportation service for the rabbits. In two thirds of the pages it is indicated that the farm also produces other game species. In conclusion, the subsector can improve the use of websites as a marketing tool, which could allow farms to gain competitive advantage in the market for restocking wild rabbits in a context of increasing competition.

CHARACTERISTICS OF WILD RABBIT FARMS IN NORTHERN PORTUGAL

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The study was conducted in order to characterize the captive rearing of wild rabbits, studying the area, structure, management and productivity of farms in northern of Portugal during the year 2010. Data collection involved face-to-face questionnaire to owners or their taskmasters in 69 farms. Farms were divided into 3 types, according to the Portuguese legislation; not licensed farms, licensed private farms and licensed associative farms. In the 69 farms there was 14 not licensed farms, (20.3%), 24 private farms (34.8%) and 31 associative farms (44.9%). The not licensed farms had 4500 m², 14 breeding animals and produced about 50 rabbits/yr (2.2 per female). The licensed private farms had in 30290 m², 112 breeders and produced annually 244 rabbits (only 1.3 per female and year). Associative farms had 14300 m², 23 breeders and produced 113 rabbits/yr (3.4 per female). The majority of farm production is sold for restocking hunting areas. There is a huge difference between the productive potential of these farms (about 26500 rabbits/yr) and the production observed (10000 rabbits/yr) due to management problems, location and facilities of many farms.

NUTRITION

EFFECT OF THE INCREASE OF THE OMEGA 3 LEVEL OF THE FEED ON THE ZOOTECNICAL RESULTS OF THE GROWING-FINISHING RABBITS

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The effects of the feed omega 3 increase on the zootecnical results (mortality, weight, feed intake, feed conversion ratio) of growing-finishing rabbits have been studied in 2 following experimentations involving 1825 “36 d old rabbits”. Three feeds were compared, the control one with a low omega 3 level (0.07%), the 2 other ones with 0.61% of omega 3 brought either by the extruded flax seed (Tradi-lin®) or by rape seeds. Globally, the mortality is highly significantly decreased by the increase of the omega 3 level in the feed and this effect is higher with Tradi-lin® compared to rape seed. The incorporation of Tradi-lin® in the rabbit feed is consequently an important

component of the programs destined to reduce or to eliminate the use of antibiotics in rabbit production. In the same time, when the omega 3 level of the feed increases, the feed intake is decreased and the feed conversion ratio is improved. In these 2 experimentations, a lower growth has been noted with the diets containing high omega 3 level, in contradiction with previous observations.

VARIATIONS OF FEEDING BEHAVIOUR PATTERN OF DOES AND LACTATING RABBITS ACCORDING TO HOUSING

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Daily feed intake of 55 does and standardized litters (9 kits) was measured from 18 to 32 d *post-partum*. Litters and does were separated at 14 d *post-partum* and mother feed intake and milk yield were measured from 14 to 18 d. Half of litters (28) remained separated until 32 d and feed intakes of litter and mother measured daily. The other half litters (27) were allocated together with her mother from 18 to 28 d and feed intake measured daily, after that doe and litter were separated until 32 d and daily feed intakes recorded separately. Total feed intake of litters and mother increased (+5%; $P < 0.01$) from 18 to 23 d when litters were allocated with her mother and feed intake of these litters were higher (+13%; $P < 0.05$) from 29 to 32 d. These results could indicate a learning of litter in feed intake at the beginning of solid intake through a modified feed behaviour of her mother.

EFFECT OF ENZYMES SUPPLEMENTATION ON CARCASS COMPOSITION AND NITROGEN EXCRETION IN GROWING RABBITS

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The aim of this work was to study the effect of an enzyme complex (activity of 100 XU/g pentosanase, 40 CMC/g of cellulase, 30 FAU/g amylase, 100 XU/g of xylanase, 700 HUT/g protease, 4000 AJDU/g pectinase and 200 BGLU/g of β -glucanase) on performance, protein retention and excretion and on carcass characteristics

of growing rabbits. Three different doses of enzyme complex (0, 100 and 200 ppm) in 2 diets with different digestible protein (DP) and digestible energy (DE) content were used (Diet A: DP: 11.9% DM; starch: 17.7% DM, NDF: 35.6% DM, DE: 10.5 MJ/kg DM and Diet B: DP: 10.7% DM, starch: 17.5% DM; NDF: 37.4% DM, DE: 9.79 MJ/kg DM). A total of 240 rabbits weaned at 34 d with an average weight of 805±47.8 g and housed in individual cages were used for this trial. During the experimental period feed intake, animal weight and body composition (estimated by Bioelectrical Impedance technique at 34 and 60 d of age in 11 rabbits/treatment) were controlled. Between days 53 and 57 of life, a digestibility test (MS, PB and EB, n=11) of the 2 feeds (A and B) for doses 0 and 200 ppm of enzyme complex was carried out. At the end of the growing period, 24 rabbits per treatment were sacrificed to determine the carcass yield. The addition of enzymes did not affect the digestibility or performance in this trial. The digestibility of DM and CE was a 3% less in diet B than in diet A ($P<0.01$). DP and DE intake was lower (13 and 10%, respectively, $P<0.01$) in animals fed with diet B, but the efficiency of DP retention was higher in diet B (74.3 vs. 68.2%, $P<0.01$), and total protein excretion was a 15% lower ($P<0.01$). As a result, protein retention was similar between feeds (7.55 g/kg PV^{0.75} d), so there was no difference in average daily gain (52 g/d) during the growing period. However, in the overall period, animals fed with diet B reached higher feed intake than animals fed with diet A, impairing the feed conversion rate (3.20 vs. 3.29, $P<0.05$). The type of feed did not affect the carcass yield.

EFFECT OF LEVEL OF SOLUBLE FIBRE AND THREONINE ON GROWTH PERFORMANCE AND DIGESTION IN RABBITS AFTER WEANING

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The aim of this work was to study whether the level of soluble fibre and threonine affects growth performance, weight of digestive tract, ileal mucin flow and ileal digestibility in weaned rabbits from 25 to 35 d of age. The experimental diets were factorially arranged combining 2 levels of soluble fibre (89 vs. 119 g/kg) and 2 levels of threonine (5 vs. 6.4 g/kg). Diets were offered *ad libitum* to 35 animals per treatment and apparent ileal digestibility and the weight of digestive tract determined. Increasing the level of soluble fibre reduced mortality by epizootic rabbit enteropathy (15.7 vs. 2.8%; $P=0.002$). Whereas

the deficit of threonine increased mortality (11.4 vs. 7.1%; $P=0.091$). The inclusion of soluble fibre improved ileal starch digestibility (90.1 vs. 92.4; $P<0.001$), but a threonine deficit decreased it low soluble fibre diets. Ileal digestibility of total dietary fibre tended to increase with dietary soluble fibre content (5.2 vs. 14.7%; $P=0.065$). However, no significant differences regarding dry matter digestibility and crude protein were observed (45.2 and 48.3% on average). Ileal flow of mucin increased by 45% (1.46 vs. 2.12 g/d, $P<0.001$) with inclusion of soluble fibre, with no effect of threonine. In conclusion, a deficit in soluble fibre and threonine worsened health after weaning in rabbits without causing relevant changes in the ileal digestibility of protein, TDF and starch.

EFFECT OF DIETARY SUPPLEMENTATION WITH ARGININE AND GLUTAMINE ON THE PERFORMANCE OF RABBIT DOES AND THEIR LITTERS DURING THE FIRST FIVE LACTATIONS

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The aim of this work was to study whether the dietary supplementation with arginine and glutamine and the eventual relationship between them influence rabbit does performance. A basal diet was formulated (C) and another 3 diets were formulated by adding 0.4% arginine (ARG), 0.4% glutamine (GLN) and a mixture of 0.4% arginine and 0.4% of glutamine (ARG+GLN) to the basal diet. Eighty nulliparous rabbit does were randomly assigned to the diets (20/diet) and controlled up to their 5th cycle. Rabbit growth were measured between birth and weaning (0, 20 and 25 d) and estimate milk production daily. Supplementation with arginine increased the number of kits born per litter (12.3 vs. 11.1; $P=0.028$) and tended to increase the number of kits born alive (11.2 vs. 10.2; $P=0.088$) reducing the litter weight at birth (0.56 vs. 0.62 kg; $P=0.031$). Interaction of arginine×glutamine was observed in the number of kits born dead being 55.6% lower for treatment without supplementation of arginine and glutamine. Milk production between 0 and 25 d was 8% higher in rabbits supplemented with arginine or glutamine compared to does fed control diet, showing an intermediate value rabbits fed with arginine and glutamine.

EFFECT OF SOLUBLE AND INSOLUBLE FRACTIONS OF SUGAR BEET PULP ON ILEAL AND CAECAL MICROBIOTA OF RABBITS AFTER WEANING

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The aim of this work was to investigate the effect of the different carbohydrate components of sugar beet pulp (SBP) on ileal and caecal microbiota in rabbits. Four semi-synthetic diets were formulated with similar level of insoluble fibre (33% NDF) and protein (16%) to isolate the effect of fibrous fraction. Control diet was formulated to contain the lowest level of soluble fibre (3% SF). A 2nd diet was obtained by substituting 60 g of starch of the Control diet by SBP pectins (8.4% SF). Two more diets were obtained by substituting part of the fibrous sources (0.4) of the control diet by either SBP or by the insoluble SBP fibre, respectively (SBP and InsSBP diets with 9.7 and 3.0% FS). Eighty weanling rabbits, 25 d of age, were blocked by litter and randomly assigned to the 4 experimental diets. Animals were housed individually and fed *ad libitum* with the experimental diets during a 10-day period. At 35 d of age all rabbits were slaughtered, sampled the digesta and the ileal and caecal microbiota were analyzed using 16S RNA RFLP technique. Ileal and caecal microbiota differed among all treatments ($P < 0.001$) and effect of treatments differed between ileum and caecum. According to Shannon index, SBP diet decreased ileal biodiversity due to a decrease of the relatively minor bacterial species, while the InsSBP diet increased these species and the ileal biodiversity ($P < 0.05$), without affecting the dominant species according to Simpson index. SBP diet resulted in the most distinct ileal bacterial community compared the other treatments ($P < 0.001$), especially compared to InsSBP diet, whereas the bacterial community from rabbits fed Control and Pectin diets showed the closest microbiota. According to Simpson index, Control diet increased caecal biodiversity, due to the decrease of dominant species, compared the other three treatments ($P < 0.05$). This is in agreement with the highest shift in bacterial community observed in rabbits fed Control diet compared the other three diets, whereas those fed SBP and InsSBP showed the closest microbiota.

EVALUATION OF SUPPLEMENTATION OF SANACORE EN ON THE PERFORMANCE OF RABBITS

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The use of additives in animal feed as prebiotics, probiotics, essential oils and other natural additives, together or

separately in rabbit feeding to maintain or improve gut health, is the basic strategy to reduce the use of antibiotics in rabbits and other animals. The objective is to maintain or improve mortality and zootechnical performance by improving feed digestibility and decreased pathogenic bacteria in the digestive tract. The synergy between them is clear and for that reason SANACORE assay using –blend of essential oils, microencapsulated butyrate and propionic and medium-chain fatty acids– in rabbits by 3 groups: GM Medicated feed; GMS medicated feed with 2 kg/tonne SANACORE and GS unmedicated feed with 2 kg/tonne SANACORE. The results is decrease in mortality (4.93% GM, 1.97% GMS and 9.86% GS) and conversion rate (GM 3.54, GMS 3.35 and 3.86 GS) in the GMS group (medicated feed supplement with SANACORE EN).

THE USE OF DIFFERENT TYPES OF OLIVE CAKE IN DIETS FOR FATTENING RABBITS. EFFECT ON GROWTH AND VISCERAL DEVELOPMENT

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In this experiment was studied the effect of addition of olive cake to diets for growing rabbits. Four diets were used, at a control diet with 10% of alfalfa (control) and 3 diets were obtained replacing the alfalfa by different types of olive cake (pressed, centrifuged and extracted; diets P, C and E, respectively). Were controlled the growth and mortality during growing period (37 to 61 d) and the digestive visceral development and caecal characteristics in rabbits with 65 d. It was observed that the final live weight tended to decrease and the weight gain was significantly lower in pressed diet than control and extracted diets. The mortality and morbidity, were higher (about 22%) but no affected by treatments. The weight and length of small intestine of rabbits were higher with diet P than diet C. The weight and length of large intestine was also higher with diet P than with control diet. It was concluded that the addition of 10% of olive cake extracted has no adverse effects on performances of rabbits.

CARCASS AND MEAT QUALITY

APPLICATION OF BIOELECTRICAL IMPEDANCE ANALYSIS (BIA) TO STUDY THE CARCASS CHEMICAL COMPOSITION OF RABBITS FROM 35 TO 63 DAYS OF AGE

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The aim of this study was the determination *in vivo* of the carcass composition of fattening rabbits from 35 to 63 d of age using the Bioelectrical Impedance method (BIA). Forty-six rabbits with live weights between 405 and 2288 g at 3 different ages (35, 50 and 63 d) were used. A 4 terminal body composition analyser (Model BIA-101, RJL Systems, Detroit, MI USA), was used to determine resistance and reactance values. The distance between internal electrodes, and body length and weight were also measured. All the animals were slaughtered and processed for chemical analyses (dry matter, lipids, proteins, ash and energy) of the carcass. Energy and fat increased with the age, while protein, ash, and humidity decreased. Mean values of resistance, reactance, impedance, animal length and distance between electrodes were 97.0±14.2 W, 21.4±4.1 W, 99.4±14.2 W, 26.71±4.6 cm and 13.6±2.9 cm.

EVALUATION OF BIOELECTRICAL IMPEDANCE ANALYSIS (BIA) TO ESTIMATE THE CARCASS CHEMICAL COMPOSITION OF RABBITS FROM 35 TO 63 DAYS OF AGE

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The aim of this study was to determinate and validate with independent data the prediction equations obtained to estimate *in vivo* the carcass composition in growing rabbits, by using the results of body composition and BIA values obtained in the previous communication. A multiple linear regression analysis was done to determinate the equations, using animal weight and length of animals, and the impedance data from the previous work (Saiz *et al.*, 2013) as parameters. Coefficient of determination (R^2) of the equations obtained to estimate humidity (%), protein (%DM), fat (%DM), ash (%DM) and energy (kJ/100 g DM) content were: 0.68, 0.58, 0.61, 0.70 and 0.98, and relative mean prediction errors (RMPE) were: 2.63, 5.07, 11.8, 2.97 and 9.22%, respectively. Reactance was

negatively correlated with water, protein and ash ($r=-0.67$, $r=-0.49$ and $r=-0.58$; $P<0.001$), and positively with fat and energy ($r=0.62$ and $r=0.69$; $P<0.0001$). Reactance was negatively correlated with water and protein content ($r=-0.29$ and $r=-0.40$; $P<0.05$) and positively with fat ($r=0.29$; $P<0.05$). Age was negatively correlated with water, protein and ash content ($r=-0.77$, $r=-0.47$ and $r=0.69$; $P<0.001$), and positively with fat and energy ($r=0.69$ and $r=0.79$; $P<0.0001$). It could be concluded that BIA it's a non-invasive technique and good method for estimate *in vivo* carcass composition of growing rabbits from 35 to 63 d of age.

REPRODUCTION

EVALUATION OF DIFFERENT EXTENDERS TO INCREASE THE PRESERVATION PERIOD OF CHILLED RABBIT SEMEN

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The aim of the present study was to evaluate and to compare the effect of four extenders on sperm motility and viability of rabbit semen chilled at 4°C for 96 h. The extenders tested differed in the sugar (glucose vs. fructose) and in the cold-shock protecting substance (egg yolk vs. semi-skimmed milk) included. Sperm viability was evaluated by eosin-nigrosin staining and sperm motility by using a CASA system. Five sperm subpopulations with different kinematic parameters were identified. Sperm motility and viability were analyzed after 24, 48, 72 and 96 h at 4°C. The extender containing glucose and egg yolk produced the highest proportion of motile and viable sperm. In contrast, extenders containing fructose and milk, after 72 or 96 h, yielded the lowest percentages of motile and live spermatozoa.

STUDY OF UTERINE AND FOETAL TRAITS OF THE RABBIT FEMALE AT 12 DAYS OF GESTATION

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The objective of this work is to analyze the characters of the uterus and fetuses at 12 d gestation in the rabbit female. A total of 55 multiparous females were used and were counted ovulation rate, ovarian weight, length and weight of the uterine horns and the number of implanted embryos. The fetuses were classified in live and dead fetuses. The available spaces per fetus, the fetal weights, and weight, perimeter, area of fetal and maternal placenta were measured. There is a positive linear relationship between weight of the ovarian and ovulation rate, weight and length uterine horn and number of implanted embryos and the

weight and length of the uterine horn. The probability of mortality of fetuses is 3 times higher if they receive a single vein than if they receive 2 or more veins, but the position of the fetus at 12 d of gestation in the uterine horn does not affect the viability of fetuses. The live fetuses have more space available if they are located in the oviduct (3.58 cm.) or cervix (3.93 cm.) that if they are in the middle of the uterine horn (2.77 cm). The longitudinal development of the maternal placenta depends on the number of veins which receives the implantation site and the position within the uterine tract.
