

ABSTRACTS OF THE FEEDING AND NUTRITION SECTION PRESENTED DURING THE “8TH WORLD RABBIT CONGRESS”

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REFLECTIONS ON RABBIT NUTRITION WITH A SPECIAL EMPHASIS ON FEED INGREDIENTS UTILIZATION. LEBAS F. *Cuniculture, Chemin de Lassère, Corronsac, France. lebas@cuniculture.info.*

In this invited communication the author proposes a list of nutritional recommendations for rabbits of different categories: growing from 18 to 42 days, from 42 to 80 days, for breeding does according to productivity (40-50 kits weaned per doe/year or more than 50) and for a single diet suitable for all rabbits. Recommendations taking account the last published data, are divided in 2 groups. The first corresponds to nutrients which contribute mainly to feed efficiency: digestible energy, crude and digestible protein, amino acids, minerals, and fat-soluble vitamins. The second group corresponds to nutrients which contribute mainly to nutritive security and digestive health: different fibre components (lignins, cellulose, hemicelluloses) and their equilibrium, starch and water soluble vitamins. In a second part, 387 papers published during the last 30 years on raw material utilisation in rabbit feeding were analysed. In a total of 14 tables, the 542 corresponding experiments were summarised each by the identification of the raw material, by the highest level of incorporation used in the experiment, by the highest acceptable level, by the main ingredient(s) replaced by the raw material studied, and finally by the authors reference. Raw materials studied were those used in temperate as well as in tropical countries. The raw material were grouped according to the

following categories: raw material used as single food (24 experiments), cereals and by-products (43 exp.), other carbohydrates source of energy (62 exp.), fats (27 exp.), full-fat oleaginous grains (10 exp.), oil cakes and meals (43 exp.), proteic seeds such peas or beans (42 exp.), miscellaneous sources of protein such yeast or leaf protein (18 exp.), animal products (21 exp.), non-protein nitrogen source such urea (9 exp.), forages (157 exp.), cereal straws, alkali treated or not (33 exp.), cover or parts of dried grains source of fibre such stalks, hulls or cobs (19 exp.) and industrial by-products usable as fibre source (51 exp.).

EFFECT OF FEEDING DIETS CONTAINING YUCCA EXTRACT OR PROBIOTIC ON GROWTH, DIGESTIBILITY, NITROGEN BALANCE AND CAECAL MICROBIAL ACTIVITY OF GROWING NEW ZEALAND WHITE RABBITS.

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Eighty-one growing New Zealand white rabbits 35 days-old were used to study the effect of feeding diets containing yucca extract or probiotic on growth performance, nitrogen utilization, digestibility, blood parameters, caecal microbial activity and relative revenue. Rabbits were randomly distributed into 3 groups fed three diets without supplementation (control), with 250 mg/kg yucca schidigera extract or with 0.5 gm/kg Lact-A-Bac (Probiotic) from 5 to 13 weeks

of age. At the end of growth experiment, six male rabbits per treatment were used to determine the digestibility and nitrogen balance. Blood and caecal samples were taken from 6 slaughtered rabbits (13 weeks old) per diet to estimate some blood parameters and caecal microbial activity. The results showed that the yucca extract or probiotic supplementation to diets significantly ($P<0.05$) affected growth performance. Average daily gain increased ($P<0.05$) by 12.1 or 9.6% for rabbits feed diets with yucca extract or probiotic respectively, as compared to control diet. Feed conversion ratio was improved ($P<0.01$) by using treatment diets with means of 3.62 for treated and 3.87 for control rabbits. Nitrogen utilization improved ($P<0.01$) by 24.3 or 16.2% for rabbits received diets supplemented with yucca extract or probiotic, respectively, as compared with control diet. Addition of yucca extract significant in crease the digestibility values of DM, CP, EE and GE by 5.4, 10.5, 6.4 and 5.0%, respectively, while efficiency of fiber utilization improved ($P<0.05$) by 13% with using probiotic. Blood and caecal urea and ammonia concentrations were reduced ($P<0.05$; $P<0.01$) by using these additives. The effect of yucca extract addition in the reducing urea and ammonia levels seems to be more effective than effect of probiotic (as average 11 and 20.1% vs. 7 and 11.7%, respectively). Additives containing probiotic recorded the highest ($P<0.01$; $P<0.01$) values were 93.2 , 10.3 and 42.9x10⁵ for total count, Lactobacilli and Cellulolytic bacteria, respectively, except for ureolytic bacteria, which recorded the lowest value (0.96x10⁵). The results showed that the supplementation of yucca extract or probiotic to diets could had a positive effect on the relative revenue. It could be concluded that the dietary yucca extract or probiotic decrease urea and ammonia levels in the blood and caecal and thus may be beneficial for improving the health, by reducing ammonia emission in rabbit buildings, for both rabbits and humans working in the rabbitry.

CHARACTERIZATION OF THE MICROBIAL DIVERSITY OF RABBIT INTESTINAL TRACT BY RESTRICTION FRAGMENT LENGTH POLYMORPHISM. BADIOLA I.* , PÉREZ DE ROZAS A.M.* , ROCA M.* , CARABAÑO R.† , GÓMEZ M.† , GARCÍA J.† , DE BLAS C.† . *CRESA (UAB-IRTA). Bellaterra, Spain.† Dpt. de Producción Animal. E.T.S.I. Agrónomos. Madrid, Spain. ignacio.badi.ola@irta.es.

Because only a small portion of the intestinal bacteria are cultivable, the development of molecular techniques, as restriction fragment length polymorphism (RFLP), allows having a better knowledge of the bacterial diversity with no culture requirements. The aim of the present study was to compare the intestinal bacterial communities present in the gut of rabbits, and its relationship with the age of rabbits and the feed formulation. The RFLP was conducted on total intestinal DNA, by the QIAamp DNA Stool Mini Kit (QIAGEN), with some modifications. A fragment of the bacterial 16S r-DNA gene was amplified by PCR with CTACGGGAGG CAGCAGT and CCGTCWATTCMTTGGAGTTT primers and digested with four different restriction enzymes (*AluI*, *RsaI*, *HpaII*, *CfoI*). Some changes have been observed in the gut microbiota by direct microscopic observation, associated to the age of the animals. These changes can be linked to some changes in the gut microbiota components, and related to these changes in the RFLP profiles can be expected. In the window of ages analysed (15, 25, and 35 days old), some electrophoretic bands reduce their intensities with the age of the animals at the same time that other bands increase their intensities. It seems that these band variations are independent of the type of diet used in the feeding of the animals. In other animal species, as pigs or chickens, the degree of biodiversity in intestinal microbiota is higher in the caecum than in the ileum, but in rabbits the relationship is inverted, with a higher biodiversity degree in the ileum. Caecotrophy could explain this difference with other species.

PROTEIN RECYCLIN IN RABBIT INCORPORATION OF MICROBIAL LYSINE IN GROWING RABBITS AS A METHOD OF MEASUREMENT. BELENGUER A.^{*}, BALCELLS J.^{*}, GUADA J.A.^{*}, GONZÁLEZ-RONQUILLO M.[†], DECOUX M.[‡]. ^{*}*Dpt. Prod. Anim. y Ciencia de los Alimentos, Fac. Veterinaria, Zaragoza, Spain.* [†]*Dpt. de Prod. Anim. FMVZ. Univ. Autónoma del Edo de México, Toluca, México.* [‡]*Cargill S.L., Barcelona, Spain.* balcells@unizar.es

The incorporation in body tissues of lysine synthesised by the microflora of the rabbit caecum was estimated by ¹⁵N labelling of microbial protein in six animals receiving a conventional diet supplemented with ¹⁵NH₄Cl (T₁), using a control group of four rabbits fed the same unlabelled diet (T₃). An additional group of six rabbits received the ¹⁵N-labelled diet, but just during the last ten days and they were provided with a neck collar (T₂). The latter group was used to estimate caecotrophes production and find out if there is any microbial lysine incorporation in non-caecotrophagic animals. The experimental diets were administered for 35 days. Then animals were slaughtered, and caecal population and tissues were sampled. Lysine was isolated from tissues, microbes and food by ion exchange chromatography and its enrichment determined by Isotope Ratio Mass Spectrometry (IRMS). T₁-rabbits incorporated ¹⁵N-lysine into the body tissues in significant amounts (0.11 (SE 0.005) atom % excess (APE)), although ¹⁵N-lysine enrichment was significantly lower than in bacteria (0.21 (SE 0.010) APE), confirming the double origin of this essential amino acid (dietary and microbial). The contribution of microbes to tissular lysine was calculated from the ratio of ¹⁵N-lysine enrichment between tissues and bacteria. So, it was estimated that the contribution of microbial labelled lysine to total lysine absorbed was 0.46. T₂-rabbits ingested the labelled diet only for ten days, but showed the same level of enrichment in caecal bacteria (0.22 (SE 0.034) APE) than T₁-rabbits. However, tissular ¹⁵N-lysine enrichment was much lower (0.02 (SE 0.003) APE), although still significantly higher than in control group. This fact shows a certain absorption of microbial lysine by non-caecotrophagic routes in rabbits,

but it represented only 14 % of total microbial lysine absorption, much lower than that obtained by the reingestion of soft faeces.

INTEREST OF HYDRIC RESTRICTION TIMES OF 2 AND 3 HOURS PER DAY TO INDUCE FEED RESTRICTION IN GROWING RABBITS. BOISOT P., DUPERRAY J., DUGENÉTAIS X., Guyonvarch A. *Evalis, BP 235, 56006 Vannes, France.*

Feed restriction is a common practice to reduce post weaning digestive disorders in rabbits but is time consuming when automatic feeders are not available. Indirect restricted feeding through hydric restriction time could be an interesting alternative. Two hydric restriction times (2 h and 3 h per day) to induce feed restriction in growing rabbits were tested on this study. Weanlings (189) were divided at 32 days of age into 3 groups: control group with unrestricted access to drinking water (group A) and 2 groups having a restricted access to drinking water from 35 to 63 days of age of 2 h/day (group B) and 3 h/day (group C) (continuously from 9 am to 11 am for group B and from 9 am to noon for group C). Body weights, mortality, food and water consumption were controlled regularly throughout the trial. Groups B and C had a growth rate over the all fattening period reduced by 10% and 8.5% compared to group A ($P < 0.001$), respectively. A restricted access to drinking water of 2 to 3 hours per day induced feed restriction in growing rabbits of -18.1% and -14.6% ($P < 0.001$), respectively. Feed conversion ratio were improved with hydric restriction ($P < 0.001$). Zootechnical results between groups B and C were not significantly different. Death rate being extremely low on this trial (2 dead rabbits over 189 rabbits at the start of the study) no conclusion of the eventual effect of hydric restriction on mortality can be taken out of this trial. Knowing that a feed restriction of at least -20% is necessary to reduce mortality and morbidity, more work would be needed to check if a shorter hydric restriction time (e.g.: one hour per day) would induce such level of feed restriction. These results are encouraging for farmers willing to use feed restriction without automatic feeders.

IMMUNE RESPONSE INDUCED BY FEED IN GROWING RABBITS. CANO J.L.^{*}, BLAS E.[†], SOLER M.D.^{*}, MOYA V.J.[†], GUILLÉN M.I.^{*} **Dpt. de Prod. Animal y Ciencia y Tecn. de los Alimentos. Univ. Cardenal Herrera-CEU. Moncada. †Dpt. de C. Animal. Univ. Politécnic de Valencia. Spain. eblas@dca.upv.es.*

Two litters of eight young rabbits, 21-day old and deprived of feed up till then, were used. Animals were identified and fed *ad libitum* on diet A or diet B throughout the experiment, until 60-day old; the rabbit does were fed *ad libitum* on diet N. Diets A and B were formulated in such a way that no raw material was present in both and diet N was a commercial diet. At the beginning and the end of experiment, samples of blood were taken from each young rabbit as well as from their mothers. Dot-immunoblotting technique was carried out to assess the existence of anti-feed antibodies in blood serums, using soluble fractions from the *in vitro* digestion of diets A, B and N as dietary antigens. Both rabbit does presented high reactivity against all tested diets in both initial and final samples. The serum of rabbits at 21-day old also showed high reactivity against all tested diets. At 60-day old, reactivity of serum of rabbits showed different pattern depending on the diet they consumed. In the most of cases of animals consuming diet A, clear decrease of levels of antibodies against diets B and N but increase or maintenance of levels of antibodies against diet A were observed. In the most of cases of animals consuming diet B, decrease of levels of antibodies against diets A and N was detected together with decrease or maintenance of levels of antibodies against diet B. These results point to the existence of anti-feed IgG antibodies in blood of adult rabbit does, transferred to litter, as well as to a specific immune response of rabbits to the feed that they consumed around weaning of variable intensity depending on the feed composition.

EFFECT OF DIETARY N-3 FATTY ACIDS ON THE COMPOSITION OF DOE'S MILK AND TISSUES OF SUCKLING RABBITS. CASTELLINI C.^{*}, DAL BOSCO A.^{*}, CARDINALI R.^{*}, MUGNAI C.^{*}, SCIASCIA E.[†] **Dpt. of Animal Sci., Perugia, Italy. †Mignini s.p.a. Perugia, Italy.*

The effect of dietary n-3 fatty acids on the fatty acid profile of doe's milk and pup's body was studied. Two experimental groups, each of 10 New Zealand White does, were fed diets enriched with α -linolenic acid (LNA) or long chain (³20C) polyunsaturated n-3 fatty acids (LCPn-3), respectively. A standard commercial feed was given to the control group. The fatty acid profile of milk was well correlated with that of the diet showing higher concentration of n-3 in both experimental diets. The fatty acid composition of plasma, liver and fat of pups was affected by the profile of the milk ingested. The tissues showed higher concentrations of LCP fatty acids by feeding does the n-3 enriched diets and the increase was higher when LCP were supplemented. The increased levels of EPA and DHA were associated with a decline in AA.

A MATHEMATICAL MODEL FOR THE LACTATION CURVE OF THE RABBIT DOES. CASADO C., PIQUER O., CERVERA C., PASCUAL J.J. *Unidad de Alimentación Animal, Dpt. de Ciencia Animal. Univ. Politécnic de Valencia, Spain. jupascu@dca.upv.es.*

The aim of this study was to compare four models considering their fitting to average lactation curve, their ability to predict individual curves and the biological interpretation of their equation coefficients. A total of 550 lactations from 134 rabbit does (from 1st to 5th lactation) were used. Four models were evaluated: quadratic function [QF; $L = a + b \cdot D + c \cdot D^2$], modified beta function [BF; $L = k \cdot (D/30)^a \cdot (1 - (D/30))^b$], modified polynomial function [PF; $L = a + b \cdot D - \frac{1}{2} \cdot D^c$] and gauss function [GF; $L = k \cdot e^{[-\frac{1}{2} \cdot ((D - m)/s)^2]}$]. In the models described, L denotes daily milk yield (g), D denotes the lactation day and a , b , c , k , m and s are the equation coefficients. All the models presented a good fitting to the average lactation curve ($R^2 > 0.97$). QF, BF and PF showed better fitting values (RSME < 5.9 g/day) than GF (RSME=8.3 g/day). Although the prediction of peak parameters was acceptable with the different models, all of them tended to underestimate both milk yield and day of maximum production. Respect to the ability to predict individual lactation curves, the proportion of "poor" fits was only around 15% and similar for all the models. The best values

corresponded to BF (85% of the curves fit with $R^2 > 0.60$) and worst-ones were obtained for GF (42% of the curves with $R^2 > 0.80$). Changes on the height and persistence of the curve result in changes on "b" and "c" coefficients of the QF and PF, being badly interpreted. In addition, these models give low information about the changes at the beginning of the lactation. In the case of BF, while changes in "a" coefficient seem to be related with changes in the milk yield of does at the beginning of the lactation, changes in "b" coefficient summarise the variations observed at the end of the lactation. In conclusion, all the evaluated models showed a good fitting to the mean and individual rabbit lactation curves. However, due to the greater independence and biological interpretation of the modified beta function coefficients, this function seems to a better model to analyse possible changes in the lactation curve shape of rabbit does.

EFFECT OF CORN PROCESSING AND LEVEL OF INCLUSION ON GROWTH OF MEAT RABBITS.

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The effect of replacing wheat grain by extruded corn (Experiment 1) and two levels of inclusion (Experiment 2) in concentrates for rabbits on digestibility, productivity and meat quality were studied on F1 (New Zealand × California) rabbits of both sexes (32 per experiment) obtained from local suppliers. In experiment 1, young rabbits were raised since 35 d to slaughter (80 d). Animals were split in two groups of 16 animals and fed with post-weaning and fattening iso-protein and iso-energy rations differing by the starch source (wheat or extruded corn grain). In experiment 2, animals were fed with the experimental rations: high (35%) and low (15%) inclusion of extruded corn grain since 40 d to slaughter (81 d). During the growing phase of experiment 1 no differences were found for nutrient digestibility, but the group receiving extruded corn grain promoted higher weight gains and final weight ($P < 0,05$). No differences were observed in slaughter yield and slaughter wastes incidence (except for the higher empty stomach weight in extruded corn

grain diet). Although, animals fed with the corn ration had a more pale meat. The hindleg of lighter rabbits fed with wheat rations had a trend to higher energy concentration and proportion of unsaturated fatty acids. Dry matter ($P < 0,05$) and energy apparent digestibilities were higher in rabbits fed with high level extruded corn grain (Experiment 2). The high corn diet allowed higher weight gains ($P < 0,05$) with lower conversion rate ($P < 0,01$). With some differences in slaughter wastes, the high corn diet induced higher carcass weights ($P < 0,05$), but with similar hindleg meat to bone ratio. *Longissimus dorsi* and hindleg were harder and more tender respectively for ration with higher corn inclusion. Meat of heavier rabbits, fed rations high in corn, had more energy content and were slightly fatter with a higher proportion of saturated fatty acids ($P > 0,05$).

EFFECT OF PRE-WEANING DIET ON RABBIT

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This study aimed to ascertain the effect of different solid feed composition during suckling on productive performance and caecal content characteristics of rabbits at weaning (28 days). From day 16, fifteen litters housed in separate cages from their mothers were administered a weaning commercial feed (Diet A) while fifteen other litters were given the same mothers' feed (Diet B). Litters were equalized at partum at eight pups and dead pups were replaced by pups of the same age from nursing does. After weaning, the rabbits received *ad libitum* diet A for 3 weeks, then a finisher diet (Diet C). From 20 to 28 days of lactation, no significant difference was observed between the two groups in milk intake (average 175 g/d/litter), solid feed intake (average 96 g/d/litter) or growth rate (average 31.7 g/rabbit). In post-weaning, significant differences were noted only during the first week, while in the whole period (28-70 d) the differences were very slight apart from the lower mortality observed in group A (3.0 vs. 8.0%). During the first week, group A rabbits consumed more concentrate (66.0 vs. 57.5 g/d) and showed

a higher daily weight gain (39.0 vs. 36.2 g) than group B. The characteristics of the caecum and caecal content in the rabbits slaughtered at weaning were similar in both groups. The obtained results indicate that administration prior to weaning of a specific concentrate for young rabbits, even if it does not greatly affect caecal fermentation and productive performance, facilitate the transition from liquid to solid nutrition, thereby reducing health risks.

DOSE-DEPENDENT EFFECT OF CELLULASE SUPPLEMENTATION ON PERFORMANCE OF EARLY-WEANED RABBIT. EIBEN Cs.^{*}, MÉZES M.[†], SZIJÁRTÓ N.[‡], KUSTOS K.[†], GÓDOR-SURMANN K.^{*}, ERDÉLYI M.[†]. ^{*}*Dpt. of Rabbit Breed. and Gen., Inst. for Small Animal Res., Gödöllő, Hungary.* [†]*Dpt. of Nutrition, Szent István Univ., Gödöllő, Péter K.u.l., Hungary.* [‡]*Dpt. of Agricultural Chemical Tech., Budapest Univ. of Tech. and Economics, Budapest, Hungary.* eiben@katki.hu.

One hundred and twenty NZW rabbits were weaned and distributed into four groups with respect to litter size and body weight at 23 days of age. Rabbits received *ad libitum* unmedicated commercial diets supplemented with high (H=52.80 FPU/kg), moderate (M=35.20 FPU/kg) or low (L=11.99 FPU/kg) levels of a cellulase complex which enzyme activities correspond to 75%, 50% and 17% of our earlier applied dose of 70.40 FPU/kg feed. The control group (C) was fed *ad libitum* the same diet but without enzyme addition. Between 63 and 77 days of age, all groups received the C diet. The rabbits were kept individually in wire mesh fattening cages (30×61×28 cm) under controlled indoor conditions (15-20°C, 16:8 L:D lighting regimen). It was concluded that supplementation of diet for early-weaned rabbits with a cellulase complex reaching 35.20 and 52.80 FPU/kg enzyme activity affects positively the production, namely, the feed conversion between 23 and 77 days of age was better (2.97, 2.91, 3.04 and 3.03 in the H, M, L and C groups, respectively; $P=0.039$). Both daily weight gain from day 23 to 77 (43.9, 43.5, 42.6 and 43.1 g, resp.; $P=0.634$) and the body weight at 77 days (2964, 2944, 2905 and 2932 g, resp.; $P=0.822$) was similar for all the groups.

Considering also animal sanitary state, another benefit was the lower ($P=0.046$) mortality caused by enteritis (3%, 13%, 13% and 20%, respectively) during the fattening period.

EFFECT OF ANISE AND FENUGREEK SUPPLEMENTATION ON PERFORMANCE OF RABBIT DOES. EIBEN Cs.^{*}, RASHWAN A.A.[†], KUSTOS K.[‡], GÓDOR-SURMANN K.^{*}, SZENDRŐ Zs.[§] ^{*}*Inst. for Small Animal Research, H-2100 Gödöllő, Hungary.* [†]*Inst. of Efficient Productivity, Zagazig University, Zagazig, Egypt.* [‡]*Lab-Nyúl Ltd., Malomtó u.8., H-2100 Gödöllő, Hungary.* [§]*Kaposvár Univ., H-7401 Kaposvár, Hungary.* eiben@katki.hu.

The study investigated the effects of diet supplementation with aniseed (*Pimpinella anisum*) and fenugreek seeds (*Trigonellae foenum-graecum*) on the performance of does and kits. Thirty eight NZW does were randomly divided into two groups (n=19) considering live weight, parity, number of born alive and litter weight after equalisation to 8 kits at first day of lactation. Three days before expected time of parturition until 17 days of lactation, control group was fed *ad libitum* a commercial diet (C), while the treated group (AF) received the same feed supplemented with aniseed (6 g/kg) and fenugreek seeds (6 g/kg). After 17th day of lactation, groups were fed the C diet and nursed freely till weaning at 35 days of age. Milk yield was daily measured until day 17 with separation of kits and weighing the doe immediately before and after controlled suckling. Between 1 and 17 days of lactation, the supplementation tended ($P=0.058$) to reduce the doe's feed intake (325 vs. 348 g/day). Mortality of AF kits tended to be higher (3.9 vs. 0.6% $P=0.056$) causing a relatively smaller 17 d litter size (7.68 vs. 7.95 $P=0.075$) and lower 1-17 days milk yield (3468 vs. 3561 g). The daily milk intake of AF kits (26.7 g) was equivalent to that of C rabbits (26.4 g). Also, the 17 days body weight did not differ significantly between AF and C kits (334 and 341 g). However, milk conversion of AF kits was lower ($P=0.011$) compared to C rabbits (1.73 vs. 1.64 g/g). At 35 days of lactation, the differences between AF and C groups were not significant in litter size (7.65 and 7.89), litter weight (6837 and 7168 g), kit weight (900 and 909 g) and 1-35 d weight gain

(23.8 and 24.1 g/day). In conclusion, further studies are needed to investigate the palatability and optimal level of these spices in the feed of lactating rabbits.

STUDY OF GLUTATHIONE PEROXIDASE ACTIVITY IN SOME ENVIRONMENTAL INDUCTION MODELS IN RABBIT. ERDELYI M.*, MÉZES M.*, VIRÁG G.†. **Szent István Univ., Fac. of Agricultural and Environmental Sci., H-2100. Gödöllő, Péter K.u.l., Hungary, erdelyi@fau.gau.hu.* †*Research Inst. for Small Animal Breeding and Nutrition, Dpt. of Rabbit Breeding, H-2100 Gödöllő, Isaszegi út, Hungary, virag@katki.hu.*

Free radicals are produced continuously in animals. Unless the presence of an efficient protective barrier, these reactive oxygen species induce processes, which end up in cellular damage, dysfunctions. In healthy animals, there is a so-called antioxidant defence system against these processes, which acts through eliminating free radicals. Glutathione peroxidase enzyme family is a prominent member of this system. The typical reaction of these selenium dependent enzyme isoforms is the reduction of reactive oxygen radicals or molecules, while their impaired electron is transferred onto reduced glutathione, which results in glutathione disulfide production. The main purpose of the study presented in the paper was the construction of a model system for studying the role of environmental factors in the regulation of glutathione peroxidase activity. New Zealand white rabbits (n=36) at 10 weeks of age were used in the experiments, as they are models for livestock animals and also often used in human research. Four induction models were studied, namely peroxide load (feed was supplemented with rancid oil -2 g/kg feed), selenium supplementation (organic selenium sources was added to the diet -0.3 mg/kg feed), glutathione depletion (per os bromobenzene treatment -13 mM/kg body weight), prooxidant load (alloxan monohydrate injection was applied -0.12 g/kg body weight). A non-treated group was also created as control for the treated ones. Blood and tissue samples were taken at certain checkpoints of the experiment for further analysis. Biochemical parameters that are used

as indicators of oxidative stress (MDA-, GSH-concentration, GSHPx activity) were measured. Induction models resulted in unanimous changes in the enzyme activity of the different observed tissues. According to the measurements, subtherapeutic dose of selenium supplementation has unfavourable effect (8-62% reduction as compared to the control data) on the GSHPx activity, which was significant in liver and testicle tissues. Bromobenzene application has induced drastic reduction in glutathione concentration (11.52 ± 0.65 mM/g and 8.04 ± 0.65 mM/g in the control and treated group respectively, $P < 0.01$), and as a result of the depletion of the enzyme co-substrate, enzyme activity has dropped. Peroxide load has shown correlation with enzyme activity of blood plasma. Alloxan treatment, modelling the prooxidant effect, resulted in total depression (98-100%, $P < 0.001$) of enzyme activity in almost all the tissues studied, however this change is related to the increased protein content of tissue samples.

THE PREDICTION OF NUTRITIVE VALUE OF RABBIT DIETS FROM TABLES OF FEED COMPOSITION. FERNÁNDEZ-CARMONA J., SORIANO J., PASCUAL J.J., CERVERA C. *Dpt. de Ciencia Animal, Univ. Politécnica de Valencia, Spain. jfernandez@dca.upv.es.*

427 diets from 134 papers on fattening rabbits published since 1968 in the main research journals were examined, in which the composition of each diet was experimentally determined, and all the ingredients of diets were listed. The following aspects were studied: experimental analyses found the diets, prediction equations for Digestible Energy (DE) and Protein (DCP) deduced from the rest of chemical fractions and a validation of Tables of Feed Composition. This last evaluation was carried out comparing the experimental value of DE or DCP reported in the papers and their calculated value assigning to the ingredients of the diets the values reported in a Table of Feed Composition. The main conclusions were: i) very few diets had an acceptable set of analysis of the nutritive fractions; ii) the values for DE and DCP deduced from values of other nutritive

fractions were similar to those already published; iii) the comparison of experimental values of diets and those deduced from a Table of Feed Composition gave a low prediction response. The utilization of tables of feeds for calculation of digestible energy of a diet seem to require a more close description of its ingredients.

THE MEASURE OF MILK RABBIT. FERNÁNDEZ-CARMONA, J., BLAS, E., CERVERA, C.; PASCUAL, J.J. *Dpt. de Ciencia Animal, Univ. Politécnica de Valencia, Spain.* jfernandez@dca.upv.es.

Records from 643 lactations were used to predict the production of 28 days from daily milk measures. Increasing from 1 to 5 measures per week the correlation coefficients and standard errors improved from 91.9 to 99.3, and from 11.2 to 3.3 g/day respectively. A 3-day weekly sample seems to be adequate in most situations ($R^2 = 98.2\%$, $RSE=5.2$) seems a suitable method for most purposes. Considering litter weight as a variable, the prediction was for 28 days clearly unsatisfactory and for 21 days was equivalent to that obtained with one measure of milk per week.

EFFECTS OF DIETARY MANNAN OLIGOSACCHARIDE IN COMPARISON TO OXYTETRACYCLIN ON PERFORMANCE OF GROWING RABBITS. FONSECA A.P.*, FALCÃO L.*, KOCHER A.†, SPRING P.‡. **Univ. Téc. de Lisboa. I.S.Agronomia, Lisboa, Portugal.* †*Alltech Biotech. Center, Sarney, Dunboyne, Ireland.* ‡*Swiss College of Agric., Zollikofen, Switzerland.* pspring@alltech.com.

Digestive disorders in rabbits are quite frequent. Therefore feed additives, which can lower the risk of digestive disorders and with it enhance performance, are useful tools to the rabbit nutritionist and stockman. The aims of the present trials were to compare the effects of mannan oligosaccharide (MOS) and oxytetracycline (OTC) on rabbit health and performance. The trial was set up as a complete randomized design comparing 4 dietary regimes with a total of 633 Hybrid Hyla rabbits in 73 cages. Commercial grower feed was introduced on day 18. Rabbits were weaned on day 28. Starter feed was offered through day 46 and

finisher feed from day 47 - 70. The diets did either contain 2000 ppm of MOS (Bio-Mosã, Alltech Inc.) or OTC (20%) in the grower and 1000 ppm of MOS or OTC in the finisher diet, respectively. The 4 treatments were as follows: Starter-Finisher: MOS-MOS, MOS-OTC, OTC-MOS and OTC-OTC. Rabbit performance and mortality was evaluated. Data were subjected to ANOVA analysis in split-plot. Overall weight gain was comparable between treatments. However the group receiving OTC throughout the trials tended to eat more feed. Due to the higher feed intake FCR was significantly higher in this group compared to the other 3 groups. Mortality was also being affected by treatment with the lowest losses in the MOS-MOS group. Under the present trial conditions performance with mannan oligosaccharide was similar or superior to performance with oxytetracycline.

PERFORMANCE OF GROWING RABBITS FED ON DIETS CONTAINING HIGH MOISTURE SORGHUM SILAGE GRAIN WITH LOW OR HIGH TANNIN CONTENTS. FURLAN A.C., SCAPINELLO C., MOREIRA A.C., MARTINS E.N., MURAKAMI A.E., JOBIM C.C. *Dpt. of Animal Sci. Maringá State Univ. PR Brazil.* acfurlan@uem.br

The performance of growing rabbits fed on isoenergetic diets containing high moisture sorghum silage grain with low or high tannin levels was evaluated. Treatments consisted of diets containing increasing levels of high moisture sorghum silage grain with low or high tannin contents (0, 33, 66 and 100%) as a replacement to corn. Eighty-four New Zealand White rabbits (42 males and 42 females), 35 days old, were allotted in a completely randomized design, with 7 treatments and 12 replications each. There was no effect ($P>0.05$) on performance, carcass per kilogram and live weight gain of growing rabbits. High moisture sorghum silage grain, with low or high tannin contents, may totally replace corn in diets of growing rabbits.

INCREASING LEVELS OF RAMIE (*BOEHMERIA NIVEA*) HAY ON THE DIETS OF FATTENING RABBITS. GABBI A.M., VIÉGAS J., TOLEDO G.S.P., IORA A.L., FRONZA L., CARLOTTO S.B. *Dpt. de Zootec., Univ. Fed. de S^{ta}. Maria, Brasil, amgabbi@mail.ufsm.br.*

In Brazil, ramie (*Boehmeria nivea*) is used like fiber source and is offered on the hay form. This study evaluated the effects of increasing levels of ramie hay in the diet on the daily weight gain (DWG), feed intake (FI) and feed conversion (FC) of fattening rabbits. The experiment was conducted in Department of Animal Science, Federal University of Santa Maria, Brazil, during April to June, 2002, there were utilized 21 animals of White New Zealand breed, males, with initial age of 44 days until 107 days of age, when were slaughtered. The animals were housed in individual cages. The experiment had three treatments: 0% ramie hay offer, 20% ramie hay offer and 40% ramie hay offer and was randomized block design, with the block criteria was birth age. The diet of animals had a high level of fiber, contributed by fiber pelleted concentrate level and an increasing of fiber level on treatments. The results were for DWG 29.85 g/day, 28.95 g/day and 25.60 g/day; for FI 73.62 g/day, 67.74 g/day and 60.89 g/day and for FC 2.49, 2.33 and 2.39 to the levels 0, 20 and 40% of ramie hay inclusion on the diets of fattening rabbits, respectively. The authors conclude that the increase in the supply of ramie hay to fattening rabbits has a negative response on the productive performance of animals, when those already receive high levels of fiber on the diet.

EFFECTS OF SOURCE OF PROTEIN AND ENZYME SUPPLEMENTATION ON PERFORMANCE OF FATTENING RABBITS. GARCÍA J.* , GARCÍA A.I.* , GARCÍA-REBOLLAR P.† , DE BLAS C.† , CARABAÑO R.† . *NUTRECO, Casarrubios del Monte, Spain. †Dpt. Producción Animal, ETSI Agrónomos. UPM, Madrid, Spain.*

An experiment was conducted to determine the effects of source of protein (soybean vs. sunflower meal) and enzyme supplementation (no enzyme, as a control diet, vs. protease vs. protease+xylanase addition) on feed intake, weight gain, feed efficiency and mortality during the fattening period. Treatments were arranged

factorially (2x3) in six isonutritive diets. One hundred and eighty New Zealand x Californian rabbits were assigned in a randomised block (litter) design to the experimental diets (30 rabbits per treatment). Animals were weaned at 35 days of age and fed *ad libitum* in individual cages during four weeks. Diets based on soybean meal showed a higher average daily gain (51.0 vs. 49.1 g; SE=0.45; P=0.005) and feed intake (138 vs. 132 g; SE=1.30; P=0.001), but a similar feed efficiency (2.69; SE=0.013; P=0.15), and a higher mortality (11.1 vs. 4.44%; SE=2.91; P=0.09) than those based on sunflower meal. Effects were higher and more significant in the first two-weeks after weaning than in the whole fattening period. Enzyme supplementation did not affect significantly (P>0.15) any of the traits studied at any period. An interaction source of protein x enzyme supplementation was observed on mortality (P=0.11), as both protease and protease+xylanase addition reduced mortality found in the control diet (10%) to 0 and 3.33%, respectively in sunflower diets, whereas no response was detected in soybean-based diets. These results agree with previous work that indicates that sunflower meal should be preferred to soybean meal in starter diets for rabbits in order to minimize digestive disorders. They also suggest that enzyme supplementation of sunflower diets might further reduce fattening mortality through a decrease of the amounts of nutrients reaching the fermentative area.

GROWTH, HEALTH STATUS AND DIGESTION OF RABBITS WEANED AT 23 OR 32 DAYS OF AGE.

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Our study compared the growth performances health and digestion of young rabbits either weaned early at 23 (group W23, n=28 litters) or at 32d (W32, n=25 litters). Litters, equalised at birth at 10 pups, were bred with their mother until weaning, in specific cages allowing to distribute separately a feed specific for young from day 16 of age, while females were fed a commercial feed. Young of both groups were fed the same diet (pellets 3.5 mm) rich in fibres

(ADF=18.5%) and lipids (crude fat=5.4%) and low in starch (6.1%). At 32 d of age, 5 rabbits from each litter were moved to collective fattening cages and fed a fattening diet (ADF=19.5%, DE=11.15 MJ/kg, starch=13.7%) till 73 d of age. From the same litters, two groups of 13 rabbits were housed from 32 till 42 d old in individual metabolism cages for digestibility measurements of the fattening diet. Feed intake results, obtained from collective cages, were corrected for mortality. Two days after an early weaning (23 d old) young rabbits consume about 60% more dry feed than those of W32 group; but their weight gain remained lower (17.2 vs. 46.6 g/rab; $P<0.01$). For 23-32d period, the weight gain was 9.4% lower for W23 (299 vs. 330 g/rab., $P=0.024$), while the feed intake was 65% higher. Rabbits of W23 group still had a 6.6% lower weight on day 52, but then they had a compensatory growth since their final weight did not differ from W32 group (meanly 2433 g at 73 days of age). Before 28 d of age, no mortality was registered whatever the group, and only 5 rabbits on 280 (from 3 litters) of W23 group died from acute diarrhoea at 30 and 31d of age. Between 32 and 45 d of age, the mortality and morbidity rates were twice higher in W23 than in W32 group (resp. 17.0 vs. 9.2%, $P=0.017$; 27.4 vs. 13.3%, $P<0.01$), while between 45 and 73 d of age, the mortality rate was slightly higher in W32 group (21.1 vs. 17.9%, $P>0.20$). For the whole fattening period, morbidity and mortality rates were similar among the two groups, although the health risk index tended to be higher for early weaned rabbits (60.7 vs. 50.8%, $P=0.11$).

FEEDING STRATEGY FOR THE EARLY WEANED RABBIT: INTEREST OF A HIGH ENERGY AND PROTEIN STARTER DIET ON GROWTH AND HEALTH STATUS. GIDENNE T., LAPANOUSE A., FORTUN-LAMOTHE L. *Inst. Nat.de la Recherche Agronomique, Toulouse Res.Center. Station de Recherches Cunicoles, Castanet-Tolosan, France.* gidenne@toulouse.inra.fr.

The performances and digestive health of early weaned rabbits were compared according to two feeding strategies. 26 litters were fed a two-feeds program (group TF), with a "Starter" diet (crude fat=6.3%, CP=19.6%, ADF=12.4%) from 18 d till

31 d, with a "Control" diet (crude fat=2.4%, CP=16.5%, ADF=17.0%) from 31 till 70 d of age. In the single-feed program (group SF) 16 litters were given only the control feed from 18 till 70 d. Litters (9 pups at 18 d) were bred with their mother, in specific cages adapted to distribute separately the experimental feeds to the litter from 18 d of age, while females were fed a commercial feed (without access to the litter). At 23 d of age, all litters were weaned but maintained in the same cage till 49 d. Then, 5 rabbits from each litter were moved to the same collective fattening cage until 70 d. Feed intake results, obtained from collective cages, were corrected for mortality. Between 18 and 23 d of age, the live weight (at 23 d=410 g) were not significantly affected by the diet (Starter vs. Control), while the feed intake was 64% higher for the most energetic diet (148 vs. 90 g per litter, respectively for TF and SF groups). The intake was slightly lower (-7%) for TF group between 23 and 31d (36.5 vs. 39.1 g/d/rab, $P=0.11$). The feed conversion between 23 and 31d was 16% lower in TF group (respectively 1.32 and 1.57 for TF and SF, $P<0.001$), with a slightly higher weight gain (33.1 vs. 30.9 g/d, $P=0.17$), in relation to the higher energetic content (+35%) of the starter diet. Between 31 and 49 d the weight gain of litters were similar among the two groups. At 70 d of age, the weight of rabbits were not affected by the feeding program, as the growth of SF group was 7% higher ($P=0.012$) between 49 and 70 d. Till the feed change at 31 d, the mortality and morbidity rates remained at a low level (<3%) and were not affected by the diet (Starter or Control feed). After 31 d (shift of feed for TF group) the incidence of digestive troubles increased sharply and led to a significantly higher mortality in SF than in the TF group in the 31 to 49 d period (24.6 vs. 15.2%, $P=0.021$). After 49 d the mortality and morbidity were again low (<7%), although the health risk index tended to be higher in the SF group ($P=0.07$). In conclusion, these results suggested that the distribution of a high energy and protein diet during the week following an early weaning improve the health status in subsequent fattening period.

DETERMINATION OF FAECAL DRY MATTER DIGESTIBILITY IN RABBITS WEANED AT 25 DAYS OF AGE. GÓMEZ-CONDE M.S., CHAMORRO S., NICODEMUS N., VILLAMIDE M.J., GARCÍA J., DE BLAS C., CARABAÑO R. *Dpt. de Producción Animal, E.T.S.I. Agrónomos. Univ. Politécnica, Madrid, Spain.* rcarabano@pan.etsia.upm.es.

The aim of this work was to study dry matter digestibility (DMd) in rabbits weaned at 25 d of age to discuss the best procedure to determine nutrient digestibility. Fifteen New Zealand × Californian rabbits from five litters (3 rabbits/litter) weaned at 25 d of age were fed *ad libitum* a diet containing 20.0% crude protein and 33.5% neutral detergent fiber (on DM basis). Feed intake and faeces excretion were recorded daily from day 25 to day 40 of age and DM digestibility determined. Litter had a significant effect on DM intake and excretion ($P=0.032$ and 0.012 , respectively) but only affected slightly DMd ($P=0.14$). Dry matter intake and DM excretion increased from day 26 to 40 of age by 158 and by 480%, respectively ($P=0.001$). A broken line regression model was fitted to DMd. It decreased linearly from weaning to day 32 of age (2.17 ± 0.25 percentage units per day), whereas from day 32 to 40 remained constant ($69.4 \pm 0.47\%$). Accordingly, it would be advisable to begin a digestibility trial not before the day 32 of age, using the first week after weaning as adaptation period. Average standard deviation of DMd decreased 54% with the length of the collection period. Consequently, the number of animals required to detect a difference among means as significant depend on the length of the collection period. For a conventional collection period of four days a difference of 2 percentage units could be detected by using 9 animals/treatment.

EFFECTS OF SOURCE OF FIBRE ON FAT COMPOSITION AND FAT RECYCLING WITH CAECOTROPHES. GÓMEZ-CONDE M.S.*, CHAMORRO S.*, MENOYO D.†, GARCÍA-REBOLLAR P.*, DE BLAS C.*. *Dpt. Producción Animal, ETSI. Agrónomos, UPM. †Dpt. Producción Animal, Fac. de Veterinaria, UCM, Madrid, Spain.

An experiment was conducted to determine the effects of dietary source of fibre on feed intake, soft faeces excretion, and fat content and fatty

acid composition of caecotrophes. Three isofibrous (NDF) diets were formulated by substituting 15% of alfalfa hay (diet AH) with oat hulls (diet OH) or a mixture (3:1) of beet and apple pulp (diet P). Dietary soluble fibre content varied from 7.9 (diet OH) to 10.3 (diet AH) and 13.1% (diet P). Eighteen New Zealand × Californian rabbits were assigned in a randomised block (litter) design to the experimental diets (6 rabbits per treatment). Animals were weaned at 25 days of age and fed *ad libitum* in individual cages during five weeks, up to an average body weight of 2.5 kg. Soft faeces excretion was individually determined throughout 24 h after putting animals a wooden collar at the neck. Ether extract content in soft faeces ground samples was determined using Soxhlet extraction with diethyl ether. All lipid samples were methylated in the presence of sulphuric acid. Fatty acid methyl esters were then analysed using a Hewlett Packard HP-6890 gas chromatograph equipped with flame ionisation detection and a $30 \text{ m} \times 0.32 \text{ mm} \times 0.25 \text{ mm}$ cross linked polyethylene glycol capillary column (HP-Innowax). Analyses were performed with a temperature program from 170 to 240°C at a rate of $1^\circ\text{C} \cdot \text{min}^{-1}$. Injector and FID detector were maintained at 250°C. Carrier gas was helium at a flow rate of $3 \text{ ml} \cdot \text{min}^{-1}$. Type of diet affected ($P=0.02$ and 0.04 , respectively) daily DM and ether extract recycling with caecotrophes, which increased from 13.6 and 0.35 (diet OH) to 15.3 and 0.43 (diet P) and 17.7 and 0.44 g (diet AH), respectively. Treatments also affected composition of fat content of caecotrophes. Ether extract concentrations of total odd-numbered and branched fatty acids, which are characteristic of microbial fat, increased ($P=0.04$) respectively from 7.2 and 6.7% (diet OH) to 9.5 and 8.8% (diet AH) and 11.4 and 9.7% (diet P). Proportion of conjugated linoleic acid, which is known to be produced in the rumen through bacterial hydrogenation of dietary linoleic acid, appeared in caecotrophes fat content in appreciable amounts ($6.7 \pm 0.5 \text{ g/kg}$), which tended to be slightly higher ($8.2 \pm 0.9 \text{ g/kg}$) in diet P. From this data it can be concluded that fat ingested with caecotrophes depends on

the amount of energy substrate reaching the fermentative area and accounts for about 12% of total fat ingested, which leads to a significant recycling of bacterial fatty acids and linoleic conjugated acid (up to 20 mg/d in diet P).

EFFECT OF THE LEVEL OF SOLUBLE FIBRE ON ILEAL APPARENT DIGESTIBILITY AT DIFFERENT AGES. GÓMEZ-CONDE M.S., CHAMORRO S., NICODEMUS N., GARCÍA J., CARABAÑO R., DE BLAS C. *Dpt. Producción Animal, UPM., Spain.*

The aim of this work was to study the effect of the level of soluble fibre on ileal apparent digestibility of dry matter and starch at different ages. Three diets were formulated to meet or exceed nutrient requirements of growing rabbits. All diets were isonutritive (33% of neutral detergent fibre, 20% of crude protein and 20% of starch) for all the nutrients except for soluble fibre. Differences in soluble fibre were obtained by a partial substitution in a control diet of lucerne hay (28% of inclusion) by oat hulls (14.7% of inclusion) or a mixture of sugar beet pulp and apple pulp (15%-5% of inclusion, respectively), resulting in soluble fibre contents of 10.3, 7.9 and 13.1%, respectively. Heat processed wheat was introduced (32.3%) as the main source of starch in all diets. Two parallel trials were conducted. Firstly, 84 growing rabbits weighting 527 ± 65 g at 35 days of age (weaned at 25 days) were slaughtered by cervical dislocation between 19 and 21 pm and the digesta of 20 cm of the terminal ileum removed. A pool of 4 animals per treatment was done due to the small amount of sample. Besides, twenty-nine New-Zealand White \times Californian doe rabbits were surgically fitted with a glass T-cannula at the terminal ileum. After a ten days period of adaptation to the diet, samples from the ileum were collected for 1 hour in the evening over a period of two consecutive days. In both trials animals were given *ad libitum* access to the experimental diets. Ileal digestibility of dry matter was not affected by the level of soluble fibre in young animals ($P > 0.05$) and was on average 46.8, 44.8 and 48.7% for oat hulls, lucerne hay and sugar beet-apple pulp diets, respectively. Despite source of starch was the same in all the experimental diets, significant

differences were found in its ileal digestibility among treatments. Rabbits fed diet containing sugar beet pulp and apple pulp showed the highest value of ileal starch digestibility respect to the oat hulls diet (96.9 vs. 93.2%, $P = 0.002$), whereas diet based on lucerne hay showed an intermediate value (95.0%). These results are in agreement with the longer length of the intestinal villi observed when level of soluble fibre increased, which varied from 722 to 492 mm ($P < 0.01$) for pulps and oat hulls diets respectively. As it was expected, ileal dry matter digestibility improved with age ($P = 0.007$), but the effect was different depending on the diet. A significant increase was observed in diets with oat hulls or with a mix of sugar beet pulp and apple pulp which reached values of 53.8 and 57.1%, respectively. Diets with lucerne hay showed the lowest improvement of dry matter digestibility (48.2%). Ileal starch digestibility was almost complete in rabbit does independently of the treatment and averaged 98.3% ($P = 0.6$). These results suggest the importance of using properly fibre sources during the post-weaning period.

STUDY ON THE OPTIMAL CRUDE FIBER CONTENT OF GROWING REX RABBIT DIET. GU Z.L., CHEN B.J., LI J., ZHAO C., DONG B., GE J. *Mountain Area Res. Inst. of the Agricultural Univ. of Hebei. 071001 Baoding. China. hebaugzl@sohu.com.*

40 healthy Rex rabbits of 40 days old were selected, divided into 4 groups randomly and fed the different crude fibre (CF) level diet. The dietary CF content was 7%, 9%, 12% and 14%, respectively. The diarrhoea incidence, growth performance and digestibility were controlled. The daily gain of the four groups was: 23.92 ± 2.68 , 25.53 ± 2.49 , 27.81 ± 2.90 and 24.80 ± 3.37 g, respectively. The third group was the best and it reached significant difference compared with the first group ($P < 0.01$) and the other two groups ($P < 0.05$). The feed conversion rate was 2.95, 2.91, 2.87 and 3.52 respectively. The third group was the lowest, and significantly different to the 4th group ($P < 0.05$). The diarrhoea frequency was 59.33%, 20.67%, 0% and 0%, respectively. The digestibility coefficients of nutrients for the different diets were: crude protein (79.68, 76.01,

75.03 and 73.19%), ether extract (89.51, 88.00, 85.86 and 85.39%), N-free extract (75.92, 74.32, 73.10 and 63.33%), ash (38.30, 36.82, 34.77 and 33.65%) and CF (20.82, 21.40, 19.66 and 17.01%), respectively. With the increase of CF content in the diet, the digestibility of all the nutrients descended significantly ($P < 0.05$). When the CF content is 7 to 9%, the differences of digestibility of ether extract, CF and ash were not significant. When the CF content is 12% and 14%, the difference of digestibility among crude protein, ether extract and ash were also not significant ($P > 0.05$). For an optimal growth and health of growth Rex rabbits, a minimum of 12% CF must be present in the diet.

EFFECT OF SUPPLEMENTAL DIETARY FAT FOR RABBITS ON MILK COMPOSITION AND REARING PERFORMANCE OF YOUNG RABBITS.

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This work was designed to determine the degree to which a supplement of rape oil added to female rabbit feeds influences the quantitative composition of higher fatty acids in milk and litter weight from birth to weaning. The present experiment confirmed that the fatty acid composition of rabbit milk lipids had been affected by the dietary fat. The fat supplement caused a decrease in the proportion of saturated fatty acids, which seems beneficial for young rabbits, just as the increase in the overall level of unsaturated acids. There were no significant differences between the groups in the number of rabbits born. The higher weaning weights of rabbits resulted from the increased amount of milk available to the litter and from the modification of the milk's fatty acid profile.

EFFECT OF PROBIOTIC BIOPLUS 2B® ON PERFORMANCE OF GROWING RABBIT.

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The aim of this work was to study the efficacy of probiotic BioPlus 2B® dietary inclusion on performance of growing rabbits in summer

conditions. One hundred and twenty Pannon White rabbits were weaned and randomly divided into two groups with respect to litter size and body weight at 35 days of age. Control group was fed a commercial and antibiotic-free diet (C). In the treated group (B) the C feed was supplemented with 400 mg/kg of BioPlus 2B®. The diets were provided *ad libitum* until 77 days of age. The probiotic inclusion corresponded to 1.28×10^6 colony forming units (CFU) per g feedstuff, i.e. 6.4×10^5 CFU/g of *Bacillus licheniformis* and 6.4×10^5 CFU/g of *Bacillus subtilis* after pelletization. Rabbits were housed individually in wire-mesh flat-deck cages (30×61×28 cm) under controlled conditions (16L:8D photoperiod). The inside temperature was 18-23°C, however, due to the hot summer, it could reach sometimes 23-26°C. The treatment did not affect 77d body weight and 35-77 d daily weight gain (2427 g and 34.4 g/day in the B group, while 2434 g and 34.4 g/day in the C group, respectively). Feed efficiency was similar for the different groups. The supplementation had a beneficial effect on the sanitary risk (3.3% and 23.3% in B and C groups, respectively), primarily due to the lower mortality between 35 and 49 days of age (0% and 71% of all losses occurred in this period in the B and C groups, respectively). With a dose of 400 mg/kg BioPlus 2B®, the morbidity was by 3% and the mortality rate by 17% lower ($P < 0.002$) compared to the C group, resulting in a 20% decrease ($P < 0.001$) in sanitary risk (morbidity + mortality) during the fattening. In conclusion, it could be advantageous to supplement the diet of growing rabbits with BioPlus 2B® in summer conditions, primarily aiming to reduce the sanitary risk during the fattening period. Nevertheless, further studies are needed to assess the efficacy of BioPlus 2B® inclusion in different environmental and housing conditions in rabbits.

EFFECT OF DIETARY SACCHARICTERPENIN TO RABBIT PRODUCTION PERFORMANCE.

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The present study was conducted to approach the possibility to substitute antibiotic with sacchariterpenin. In the study 36 growing California rabbits at similar age were divided into 3 groups. For group of the control olaquinox was applied and for group I and group II 200 ppm and 400 ppm sacchariterpenin were applied. The results of this 7-week experiment were the following: (1) The daily gain and feed conversion ratio for the group of control and group I and II were 23.9, 22.0, 24.5 g/d and 3.9, 4.1, 3.8 respectively. Compared with the group of control, daily gain of the group I decreased 7.9% ($P>0.05$) and the feed conversion ratio increased 5.1% ($P>0.05$). In the case of group II, the daily gain increased 2.5% ($P>0.05$) and conversion ratio decreased 2.6% ($P>0.05$). (2) In the group of control, group I and group II 5, 5 and 4 rabbits were infected with diarrhea and 1, 1 and 0 rabbits died. Although the number of observations is small, these results suggest that sacchariterpenin at level of 400 ppm could be used as an alternative to olaquinox.

COMPARATIVE STUDIES ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY, IMMUNITY INDEX AND PROTEASE ACTIVITIES BETWEEN WEANING-2 MONTH AND 2-3 MONTH NEW ZEALAND RABBITS. LI FU-CHANG*, LEI QIU-XIA†, ZHANG XIULING‡. *College of Animal Sci. & Tech., Shandong Agric. Univ. Tai'an, Shandong Prov., China. chlfi@sdau.edu.cn. †Shandong Academy of Agric. Sci. Jinan, Shandong Province, China.

The experiment was carried out to study the effects of different age on production performance, nutrient digestibility, immunity index and small intestine protease activities of New Zealand rabbits. Twenty weaned rabbits were raised and the rabbits were allocated to weaning to 2 months and 2 to 3 months. The results showed as following: The average daily gain of weaning to 2 months rabbits was higher than that of 2 to 3 months ($P<0.05$), which are 33.4 g and 29.6 g; the feed/gain rate of weaning to 2 months rabbits was lower than that of 2 to 3 months ($P<0.05$), which are 2.93:1 and 4.41:1. The nutrient apparent digestibility of 2-3 months rabbits was higher than that of weaning-2 months, there into, the average apparent

digestibility of crude protein of 2-3 months and weaning-2 months were 72.0% and 68.1%, respectively. The average nitrogen retention of 2-3 months and weaning-2 months were 1.5 g/d and 1.3 g/d. The immunity index of different age rabbits has not obvious change, the protease activities descended when age increased.

THE EFFECT OF ADDITIVE NAMED "JIAN TU SAN" IN FEED UPON THE PRODUCTIVITY OF REX RABBIT. LIU Y.F.*, GAO Z.H.†, WANG P.*, ZHAO F.C.‡, ZHANG B.Q.§. *Hebei Inst. of Vet. Drug Control. Shijiazhuang, China. †Hebei Inst. of Husbandry and Vet. Baoding, China. ‡Hebei Acad. of Agric. and Forestry Sci., China. §Hebei Agric. Univ. Baoding, China.

The Rex rabbit was used to study the effect of "Jian Tu San" additive at three levels (10 g/kg, 20 g/kg, 30 g/kg) on feed upon the weight-gain, meat quality and the fur quality. The results show that the rate of weight-gain of three test groups was 15.47% ($P<0.05$), 25.88% ($P<0.01$) and 24.12% ($P<0.01$) higher respectively than that of the control group. The conversion index of the groups was 13.41%, 22.03% and 20.15% lower respectively than that of the control group. The group 3, 4 presented a remarkably higher coarse protein digestion rate. The test group 3 has a very remarkably higher fat digestion rate ($P<0.01$). The test group 4 only has a remarkably higher fat digestion rate ($P<0.05$). Variable quantities of the additive have no remarkable effect upon dressing percent, the meat quality and fur quality. Though the meat ripening rate, leather area, hair density have a trend of increasing respectively, the difference was not remarkable ($P>0.05$). In conclusion, the results of the present work shows that the inclusion of "Jian Tu San" additive could improve the performance (digestibility and growth) of Rex growing rabbits without any effect on meat and fur quality.

NUTRITIVE VALUE OF DIETS CONTAINING ALFALFA HAY AND WHOLE CORN PLANT TO GROWING RABBITS. LUI, J. F.*, ANDRADE, B.R.P.*, OLIVEIRA, M.C.†, ARANTES, U.M.‡, CANCHERINI, L.C.*, CAIRES D.R.* *Dpt. Zootecnia, Univ. Estadual Paulista, SP. Brazil. †Dpt. de Zootecnia, Fundação do Ensino Superior de Rio Verde, Brazil. cristina@fesurv.br

The real actual utilization of a feed depends on its nutrient availability and the first step should be to determine its nutritive value. The objective of this experiment was to evaluate the apparent digestibility of diets containing alfalfa hay and whole corn plant using growing rabbits. Eighteen New Zealand White rabbits were allocated in a completely randomized design with two treatments (diets containing alfalfa hay or whole corn plant) and nine replications. Alfalfa hay and the whole corn plant were grounded and, after the a 9% soybean oil addition, they were pelleted. The diets with alfalfa hay had CP 17.52%, CE 4,910 Mcal/kg, NDF 55.51% and ADF 46.07% and with whole corn plant had CP 6.96, CE 5,000 Mcal/kg, NDF 57.71% and ADF 34.34%. The experimental period lasted 19 days, 12 for adaptation to the diets and cages and seven to feces collect. There was no significant difference between the digestibility coefficients of both diets to dry matter, crude energy and ether extract. However, there was a significant difference ($P < 0.01$) to crude protein, acid detergent fiber and neutral detergent fiber results. The best digestibility coefficient for crude protein (76.08%), acid detergent fiber (36.32%) and neutral detergent fiber (40.14%) was observed for the diet with alfalfa hay. These results suggest that the diet with alfalfa hay can be better used by growing rabbits than the one with whole corn plant.

NITROGEN AND PHOSPHORUS EXCRETION IN RABBITS: A CALCULATION BASIS FOR COMMERCIAL FARMS. MAERTENS L.^{*}, CAVANI C.[†], PETRACCI M.[‡] *Centre for Agric. Res. Dpt. of Animal Nutrition and Husbandry, Melle, Belgium. l.maertens@clo.fgov.be. †Dpt. of Food Sci., Univ. of Bologna, Bologna, Italy.*

In several areas with a high density of animal production, manure is no longer exclusively considered as a fertiliser. In order to limit the production or a more environmental friendly use, efforts are done to reduce the mineral excretion. In such a context, both from governmental side as for the producer a reliable calculation of the on farm production is useful. Based on the input (feed) output (produced rabbits, dead rabbits) balance, the nitrogen and

phosphorus farm excretion is calculated for different production systems. For a closed farm (breeding + fattening) the most convenient expression of mineral excretion is per female on average present in the farm. The excretion amounts 7.56 kg N and 4.72 kg P₂O₅ per doe /year in a commercial rabbit farm based on an average production/doe of 45 fatteners of 2.5 kg. In an exclusively fattening unit (between 0.8 and 2.5 kg weight and a feed conversion ratio of 3.25), the excretion amounts 88 g N and 60 g P₂O₅ per produced rabbit.

EFFECT OF A SPECIFIC FEEDING PROGRAM BASED ON HIGH ENERGY LACTATION AND PREGNANCY DIETS ON RABBIT DOES AND YOUNG RABBITS PERFORMANCES. MONTESSUY S., MOUSSET J.L., FERCHAUD N. *TECHNA, BP 10, 44220 Couëron, France.*

In order to find an unique nutritional response to does and young rabbits fed at the same time, a specific feeding program including two high energy diets (group B) was compared to a classical program based on an unique moderate energy diet (group A) during 3 cycles. Group B is composed by lactation feed given from 2 days before parturition up to 21 days after and by pregnancy-weaning feed given from 22 days after parturition up to 2 days before next one, while group A is composed by one control feed. The use of high energy diets shows some positive effects: does weight and young rabbits weight at 22 days old during cycle 2 and 3 are increased for group B (4637 g for does in group A vs. 4711 g in group B; 358 g for young rabbits in group A vs. 379 g in group B). There is less mortality of young rabbits between birth and weaning in group B (13.2% in group A vs. 11% in group B). The use of such energetic program leads to higher number of weaned rabbits per artificial insemination: 7.31 for group B vs. 6.99 in group A.

EFFECTS OF FRUCTO-OLIGOSACCHARIDES ON PERFORMANCES OF GROWING RABBITS. MOURÃO J.L., ALVES A., PINHEIRO V. *CECAV-Univ. of Trás-os-Montes e Alto Douro, 5000-911 Vila Real, Portugal. jlmourao@utad.pt.*

A common problem in rabbits is the occurrence of digestive disorders just after weaning. This problem is associated with instability of the cecal microflora, and characterized by diarrhea, loss of appetite and increased mortality. The supplementation of diets with fructo-oligosaccharides (FOS) can improve animal's health and performances by selective stimulation of beneficial endogenous bacteria in the cecum. A trial with the objective of evaluating the effects of FOS on growth performances and intestinal morphometry of growing rabbits was conducted. A total of 144 mixed-sex growing rabbits (817±35 g) were submitted from 35 to 70 days of age to 2 experimental treatments. The 2 treatments were applied to a common basal diet as follow: 1) Control (no FOS); 2) FOS (0.36 g.kg⁻¹ diet). Experimental diets were offered *ad libitum*. No statistical differences on mortality and diarrhea frequency were observed during the essay. The Control and FOS rabbits had similar live weights at 35 (821 vs. 812 g), 49 (1107 vs. 1146 g) and 70 days (2223 vs. 2234 g), weight gain and feed intake. However, the feed efficiency on the growing period tended to be higher with FOS diet (0.274 vs. 0.304; $P=0,056$). No significant effects are observed on morbidity and mortality. FOS did not affect the weights of liver, cecum, small intestine and stomach. Also the ileal villi measurements did not show differences between treatments. Results of this study suggest that FOS increase feed efficiency and have negligible effects on growth performance and microbial activity.

FATTY ACIDS OMEGA-3 IN MILK OF RABBITS DOES FED COMMON VETCH AND SARDINE OIL.

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Four dietary treatments were assessed: AASO (alfalfa 66.95% and soybean oil 4.5%), VASO (common vetch 75.74% and soybean oil 5.33%), VASA (common vetch 75.83% and sardine oil 5.18%), and ALCO (commercial feed) on breeding does, of 3.2 kg during their first 2 lactations

without homogenizing litters. The assessed variables were: content of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in milk fat. The feed was offered in pellets *ad libitum*. Milking was done manually. The milk concentration of DHA showed differences ($P<0.02$) among means of 0.36, 0.55, 1.26, and 0.15 mg mL⁻¹, corresponding to the order of the indicated feeding treatments. EPA content was different ($P<0.01$) by effect of treatments 1.72, 1.86, 3.64, and 0.94 mg mL⁻¹, according to the mentioned order. As it was expected, rabbits fed oils rich in omega-3 fatty acids are capable of delivering these acids into their milk.

EFFECT OF LEVEL OF FIBRE AND LEVEL OF GROUND OF FIBRE SOURCES ON DIGESTION AND ILEAL AND CAECAL CHARACTERIZATION OF MICROBIOTA OF EARLY WEANED RABBITS.

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The aim of this work was to study at two different levels of fibre (LF) the effect of increase dietary particle size in diets for early-weaned rabbits. Four isonutritive diets arranged in a factorial design 2×2 including LF (30 vs. 25% NDF) and type of ground of main sources of fibre, alfalfa hay and straw, (coarse-grounded at 9 mm vs. normal-grounded at 1 mm) was used. Diets with 30% of NDF contained 19.5, 8.0, and 4.2% of alfalfa hay, cereal straw and lard, respectively. Diets with 25% NDF contained 11.6, 4.8 and 16.6% of alfalfa hay, cereal straw and wheat flour, respectively. The other ingredients were common to all diets (26% Wheat, 15% Wheat bran, 18% Sunflower meal and 4% Beet pulp). Diets included zinc-bacitracine and apramicine sulphate and an enzymatic complex constituted by amylase, xylanase and b-glucanase. Alfalfa was washed and the insoluble fraction was marked with Yb and included in a 0.5% in the diets in order to determine ileal digestibility. Particles larger than 0.3 mm and NDF larger than 0.3 mm decreased from 35.1 and 23.4% to 19.8 and 14.0% respectively, for coarse 30% NDF and normal 25% NDF diets, respectively. Particle

size was determined by wet sieving. Two hundred rabbits weaned at 25 d were blocked by litter, caged individually and assigned randomly to the treatments. Diets were offered *ad libitum* from weaning to slaughter (55 d of age) and mortality was recorded. Eighty rabbits weaned at 25 d were used to determine faecal (from day 35 to 39) and ileal digestibilities. At 39 d of age, the animals were slaughtered and ileal digesta collected to determine ileal digestibility. Another 40 rabbits were slaughtered at 39 d of age to collect the ileal and caecal digesta to characterize the microbiota by molecular techniques (Restriction Fragment Length Polymorphism). The reduction of LF increased mortality from 25 to 55 d of age (8 vs. 17%, $P=0.05$), but no effect of type of ground was observed. The mortality was due to mucoid enteropathy. Low fibre diets showed higher digestibilities of DM and CP than diets with 30% NDF both at ileal (52.9 vs. 60.0% and 72.4 vs. 77.5%, respectively, $P<0.01$) and at faecal level (73.9 vs. 67.1%, and 85.6 vs. 82.3%, respectively, $P<0.01$). However, ileal and faecal digestibility of starch (96.8 and 100%, respectively) and faecal digestibilities of NDF and ADF were not affected by LF (32.9 and 22.0%, respectively). Coarse-grounded diets led to a reduction of NDF and ADF digestibilities (by 8.5 and 16.5%, respectively). Unlike to that observed in pigs and poultry, microbiota in rabbits showed higher biodiversity at the ileum than at the caecum (1743±192 (SEM) vs. 623±109 number of sequences recognised in the data base, SSU_Unal.gb (Ribosomal Database Project, respectively). The degree of similarity between caecal and ileal microbiota was of 65%. High fibre and coarse-grounded diets showed a reduction ($P<0.05$) of ileal biodiversity (31 and 40%, respectively). Within identified bacteria, coarse-grounded diets reduced in the ileum the presence of genera like *Escherichia*, *Helicobacter* or *Klebsiella*. Caecal microbiota showed higher stability among diets than at the ileum. An interaction between LF and type of ground was detected ($P=0.01$). Low fibre and coarse-grounded diet reduced the biodiversity with respect to others three diets (266 vs. 743 number of sequences, respectively). Low fibre

diets reduced the presence of genera like *Bacteroides* respect to diets with 30% FND. These results suggest that gut microbiota can be modulated with diet.

LIPE® MARKER FOR ESTIMATING TOTAL FAECAL PRODUCTION AND DRY MATTER APPARENT DIGESTIBILITY IN GROWING RABBITS. PEREIRA R.A.N.* , SALIBA E.O.S.† , MOTTA W.F.† , BERTECHINI A.G.* , DONATO D.C.Z.* , DUARTE M.R.* , CHAVES, M.L.* *Dpt. de Zootecnia. (UFLA). Brasil. rapocalypse@bol.com.br. †Dpt. de Zootecnia. UFMG. Belo Horizonte, MG Brasil.

LIPE®, a purified lignin, was used as external marker in growing rabbit diets containing different levels (0, 8, 16, 24 or 32%) of dried citrus pulp (DCP). The reference diet was formulated to meet the nutritional requirements of growing rabbits and was isometrically substituted by one of four levels of DCP. Also, 0.77% of vitamin-mineral premix and salt was added to all diets. During four days, thirty five animals have received orally one mL of LIPE® solution. Lignin was measured in the faeces and in the ingredients using the infrared spectrophotometer. The dried matter (DM) faecal production and the digestibility coefficient (CD) of DM using LIPE® were obtained by a formula and compared to the total faeces collection. The LIPE® has resulted in similar values of total collection, except for 24% DCP diet, which has shown over time values of faecal production using the marker. However, significant differences were detected for CD of DM values. In the highest levels (16, 24 and 32%), the use of LIPE® underestimated the values compared to total collection method values. LIPE® was efficient as external marker in growing rabbits diets using reduced levels of DCP (0 and 8%).

EFFECT OF MANNAN OLIGOSACCHARIDES ON THE ILEAL MORPHOMETRY AND CECAL FERMENTATION OF GROWING RABBITS. PINHEIRO V.* , ALVES A.* , MOURÃO J.L.* , GUEDES C.M.* , PINTO L.* , SPRING P.† , KOCHER A.‡ *CECAV, Univ. of Trás-os-Montes e Alto Douro, Vila Real, Portugal. vpinheiro@utad.pt. †Swiss Coll. of Agric. Zollikofen. Switzerland. ‡Alltech Biotech. Centre, Dunboyne, Ireland.

A common problem in rabbits is the occurrence of digestive disorders just after weaning. This problem is usually associated with instability of the cecal microflora and characterized by diarrhea, loss of appetite and increased mortality. In the current study the effects of a mannan oligosaccharide (MOS, Bio-MOS[®], Alltech Inc. USA) was compared to a commonly used antibiotic (AGP, Zn-Bacitracin). The current study investigated the effects of MOS and AGP on intestinal morphometry and cecal VFA production. A total of 220 weaned mixed-sex rabbits (32d) were divided into 5 experimental treatments and housed in groups of 4 in 55 flat deck cages located in an experimental rabbit house. The 5 experimental treatments were as follow: Control (no additives); MOS1 (1 kg MOS/t); MOS1.5 (1.5 kg MOS/t); MOS2 (2 kg MOS/t) and AGP (0.1 kg/t). Experimental diets were based on alfalfa, sunflower meal and wheat and beet pulp and were offered *ad libitum* through out the experiment. Intestinal morphology and cecal fermentation was determined in 8 rabbits per treatment slaughtered at d46. Histologic examination showed significantly longer villi ($P<0.05$) in rabbits fed MOS (503.1, 518.6 and 508.8 for MOS1, MOS1.5 and MOS2, respectively) or AGP (502.5) compared to the control group (403.0). This was also translated into a numerically increased absorption surface. Cecal volatile fatty acid (VFA) concentration differed significantly ($P<0.05$) between treatments. Rabbits fed MOS at 1 kg/t had the highest total VFA concentration (98.02 vs. 51.57 in MOS 1 and Control) and higher butyric acid (14.09 vs. 4.59 in MOS1 and Control). Furthermore cecal pH was significantly lower in rabbits fed MOS at 1 kg/t and 2 kg/t (5.79 and 5.92) compared to the control (6.33). Results for this study suggest that MOS has a stimulating effect on villi development and production of cecal VFA and reduce cecal pH, which could improve the health status of growing rabbits.

EFFECTS OF ZINC BACITRACIN ON PERFORMANCE, DIGESTIBILITY AND CAECAL DEVELOPMENT OF GROWING RABBITS. PINHEIRO V., MOURÃO J.L., ALVES A., RODRIGUES M. SAAVEDRA M.J. *CECAV. Univ. of Trás-os-Montes e Alto Douro, Vila Real, Portugal.* vpinheir@utad.pt.

Zinc bacitracin is an antibiotic growth promoter (AGP) commonly used in rabbit production to prevent mortality provoked by epizootic rabbit enterocolitis in the growing period. In 3 trials, mixed-sex weaned rabbits were used to evaluate the effect of zinc bacitracin on 1) growth performances and mortality; 2) digestibility; 3) caecal development and concentrations of caecal bacterial populations. Two experimental treatments were applied to a common pelleted basal diet as follow: Control (no AGP); and AGP (0.1 g Zn-Bacitracin kg⁻¹ diet). Experimental diets were offered *ad libitum* from the weaning (32 days of age) to the end of trial. On the growth trial 160 rabbits were controlled from day 32 to day 67. The weight of rabbits at 67 days with antibiotic and control were 2024 and 2026 g, respectively. Although not significantly ($P=0.17$), the AGP group showed lower mortality values (2.5%) than the control (8.8%). In the digestibility trial, 2 groups of 10 rabbits were allotted to the previous dietary treatments. Digestibility was measured from d41 to d46. The zinc bacitracin did not significantly affect the digestibility of major diet nutrients. In the third trial 8 rabbits per treatment were slaughtered at d46. No significant effects of AGP on caecal development were found. However, the AGP group showed lower levels of caecal bacterial populations as well as lower pH values ($P<0.05$).

FEEDING PROGRAM FOR YOUNG RABBIT DOES ACCORDING TO THEIR GENETIC LEVEL.

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A total of 167 crossbred young rabbit does were used to study the combined effects of: i) genetic level of the females (H1 vs. H2 females come from the cross of old and current generations of maternal lines selected for litter size); ii) the feeding program during the rearing period: *ad libitum* distribution of a high fibrous diet (F) or restricted distribution of a middle energy diet (M); iii) and, the pre-partum feeding program: high energy diet (E) or middle energy diet (M) on the development of young rabbit does until their first parturition and the main litter traits at

first kindling. H2 does presented a significant larger number of total and alive pups at birth (+2.06 alive pups) than H1, greater than that expected (+1.06). The use of a high-fibre diet significantly decreased the weight gain of does during the rearing period (-294 g), but increased it during the first 4 weeks of gestation (+79 g) as consequence of a higher energy intake. The feeding program during the rearing period did not influence the fertility of does at first AI. Does receiving F diet until 28th day of gestation showed a significantly greater energy intake during the pre-partum and their number of pups born alive was significantly lower (-1.3 pups), showing that its combination with a high energy diet during the pre-partum period could affect the reproductive traits. In conclusion, it appears from the results of this trial that, when crossbred nulliparous rabbit does pertaining to old and current generations from two lines selected by litter size criteria are contemporarily compared, the selection response seems to be greater than that expected. In addition, *ad libitum* distribution of high-fibre diets from 3 months of age did not affect the fertility of does at first AI, but its combination with a high energy diet during the pre-partum period could decrease the number of born alive pups.

EFFECT OF FREQUENT WEIGHING ON THE PERFORMANCE OF GROWING RABBITS.

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The aim of the experiment was to study the effects of weighing frequency on the performance of growing rabbits. Rabbits were weaned at 21 (n=108) or at 35 days of age (n=108). Both groups were halved. One part of the rabbits was weighed weekly (frequently, W21 and W35 groups) and the others were weighed only at the beginning and at the end of the experiment (control, C21 and C35 groups). Feed intake and mortality were recorded weekly. Frequency of weighting had no influence on body weight, feed intake and feed conversion. The difference in the total mortality of frequently weighed and control rabbits was independent

of the treatment. Experimental results showed that frequent weighing did not affect the growing performance of rabbits.

STUDY OF THE DIETARY ENERGY AND PROTEIN CONTENT FOR GROWING REX RABBITS FROM WEANING TO MARKETING. REN K.L.* , LI Y.P.* , HU Y.S.†, LIANG Q.Z.* , LUO H.D.* *Inst. of Animal Husbandry and Vet. Sci., Shanxi Acad. of Agric. Sci. Taiyuan, China. †Agric. Bureau in Yangquan, China.

In present experiment 132 weaned rabbits of 35 or 45 day old were used to study the nutrition requirements of growing Rex rabbits from weaning to marketing. They were divided into four groups and fed one of the 4 experimental diets: low energy high protein (10.97 MJ D /Kg, 18.98% CP), high energy high protein (11.31 MJ DE /Kg, 19.36% CP), high energy medium protein (11.31 MJ DE /Kg, 17.37% CP) and low energy medium protein (10.72 MJ DE /Kg, 17.40% CP). Growth performance and hair coat quality was studied till 15-17 weeks of age. Daily gain from weaning to marketing was not significantly different ($P>0.05$). The levels of digestible energy of the diet played a regulating role to the feed intake; and the high level of energy and protein promotes a favorable feed conversion ratio. The high protein low/high energy diets played an effective role to increase the quality of hair coat, while high energy medium protein diet of DE 11.31 MJ/Kg and CP17.37% was not good for that purpose. In conclusion, two diets, one with DE 10.97 MJ/Kg and CP18.98% and the other with DE 11.31 MJ/Kg and CP19.36%, showed positive effect to improve quality of Rex rabbit hair coat.

STUDY OF THE DIETARY ENERGY AND PROTEIN LEVELS FOR REPRODUCING REX RABBITS.

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In present experiment to study nutrition requirements of energy and crude protein of the reproducing rex rabbit, four groups were designed as the following, high energy high protein group 1 of 11.31 MJ DE /Kg and 18.73%

CP, low energy high protein group 2 of 10.71 MJ DE /Kg and 19.54% CP; high energy medium protein group 3 of 1.31MJ DE1/Kg and 17.02% CP, and low energy medium protein group 4 of 10.47 MJ DE /Kg and 17.48% CP. The results of 127 litters show that, pregnant rabbits on group 4 got the highest litter size, the survival rate and initial litter weight. And when the diet for the lactating does is on 10.71 MJ DE/Kg 19.54% and crude fiber 12.52% it is favorable to improve litter size and litter weight at weaning at 35 d.

DIGESTIVE ENERGY AND CRUDE PROTEIN LEVEL FOR GROWING REX RABBITS. REN K.*[†], LI Y.*[†], LIANG Q.*[†], REN J.*[†], LUO H.*[†], TANG Y.*[†], HUANG S.*[†] *Inst. of Animal Husbandry and Veterinary Sci., Shanxi Academy of Agric. Sci., Taiyuan China.* [†]*Shanxi St. of Animal & Poultry serv., Taiyuan China.*

In recent years a lot of works have been focused on nutrition requirement for meat-purpose and Angora rabbits and remarkable achievement has been got. In recent year some feeding standards for meat rabbit have been presented and played important role in meat and Angora rabbit production. However, systematic approaches to nutrition requirement for fur purpose rabbit is rather limited. At this situation though standards for meat and Angora rabbit are taken as reference in fur-purpose rabbit production, it is far to meet the quality and efficiency goals. In present experiment, 72 Rex rabbits at the age of 100 d were applied to study energy and crude protein requirements for growth. Four groups were designed as: Group 1 high-energy high-protein diet (DE 11.17 MJ/Kg, CP 18.44%); Group 2 high-energy medium-protein diet (DE 10.98 MJ/Kg, CP 16.29%); Group 3 low-energy high-protein diet (DE 10.53 MJ/Kg, CP 19.29%); and Group 4 low-energy medium-protein diet (DE 10.26 MJ/Kg, CP 16.05%). The results of growth and coat hair quality measurements at 47 days suggested that: 1) When diet with digestive energy of around 11 MJ/Kg was used, it was good to improve growth rate and feed efficiency, and yield of carcass. In the range, the diet with DE 11.17 MJ/Kg and CP 19.29% got the best growth rate and feed efficiency. 2) When the diet with digestive energy of around 10.4 MJ/Kg and

crude protein between 16.05%-19.29% was applied, it was good to coat hair quality. Therefore, on purpose to get fine quality fur from Rex rabbit, it better to use feed with 10.4 MJ DE/Kg.

EFFECT OF DIETARY PEASHRUB ON RABBIT PERFORMANCE AND CARCASS TRAITS. REN K.L.*[†], NIU X.W.*[†], HE D.C.*[†], XIAO B.Y.*[†], HUANG S.F.*[†], LI Y.P.*[†] *Animal Husbandry and Vet. Inst., Shanxi Academy of Agric. Sci., Taiyuan, China.* [†]*Shanxi Academy of Agric. Taiwan, China.*

In present peashrub feeding experiment, 60 hybrid rabbits at the age of 45-48 d with an average body weight of 1050 g were divided into 4 groups. In the diet of the control group, ratio of millet grass was 33.4%. In groups I, II and III, 10%, 20% and 33.4% peashrub meal was supplied to substitute correspondent ratios of millet grass respectively. The results of this 48-day experiment showed that mean daily feed intake, daily gain and feed conversion rate for the group of the control and the groups I, II and III, were 89.8 g, 93.0 g, 90.8 g and 80.0 g; 22.6 g/d, 23.3 g/d 19.2 g/d and 17.9 g/d; and 3.98, 3.99, 4.72 and 4.74, respectively. The difference in daily feed intake, daily gain and feed conversion rates between groups were not significant. In addition, the results of slaughtering showed that carcass weight, dressing out percentage, slaughter yield and meat to bone ratio were not significant between groups of I, II and the control ($P > 0.05$). On the contrary, for the group III, all above-mentioned indexes were considerably lower than those of the control ($P < 0.05$). Although future works are required with a greater number of observations, the results of the present experiment suggest that a supplement of 10% - 20% peashrub in rabbit diets is feasible.

USE OF CASSAVA MEAL RESIDUE ON RABBIT FEEDING. SCAPINELLO C., MICHELAN A.C., FURLAN A.C., MOREIRA I., MARTINS E.N., MURAKAMI A.E. *Dpt. of Animal Sci., Maringá Univ. State. Brazil.* escapinello@uem.br.

Two assays were carried out to evaluate the digestibility of nutrients, energy and

performance of growing rabbits fed on diets containing cassava meal residue (CMR), fiber variety. CMR is a residue from the cleaning of the material found on industrial premises factory in the production of cassava meal. It consists basically of cassava meal that may not be used for human consumption and of root tips from the pre-processing cleaning stage. Twenty-two 50-day-old rabbits were used in the digestibility assay, in a randomized design, with two treatments and 11 replicates. CMR substituted 25% of dry matter in control diet. Digestible dry matter, digestible protein, digestible neutral detergent fiber, digestible acid detergent fiber, digestible energy and digestible starch, of CMR, on the dry matter basis, were, respectively 85.87%, 1.43%, 2.82%, 0.91%, 3562 kcal/kg and 63.95%. One hundred and eighty rabbits, 35 day-old, were distributed in randomized blocks, with six treatments (diets), 15 replicates of two animals per experimental unit, in a performance experiment until 70 days of age. Diets consisted of isobalanced levels of protein, methionine + cystine, lysine, energy, calcium and phosphorus. CM gradually replaced corn digestible energy (0, 20, 40, 60, 80 and 100%). Results showed that CMR might be added to the diet of growing rabbits from weaning to slaughter, substituting totally the digestible energy of corn.

EFFECT OF DRINKING WATER TEMPERATURES AND SOME DIETARY FEED ADDITIVES ON PERFORMANCE OF HEAT STRESSED RABBITS.

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A twelve-treatment experiment was carried out to overcome some of the negative effects of heat stress (>30.0°C; 6 hours a day from 12 noon to 6 pm) on performance of 120, 7-week-old NZW × Californian rabbits up to the 14th week of age. The interaction between drinking water temperature (normal; NW 29-32°C or cold water; CW of 16-20°C) and studied dietary feed additive [without supplementation (control), or with vitamin C (300 mg/kg diet), potassium chloride (KCl; 0.5%), copper as copper chloride (200 ppm), commercial enzymes mixture

(Kemzyme; 1 kg/ton) or glycine (0.5 kg/ton)] was studied in 2x6 factorial arrangement. Results indicate that studied water temperatures or feed additives, on average, did not significantly affect total weight gain (WG), feed intake (FI), feed conversion ratio (FCR), rectal temperature, total edible parts (%), plasma glucose, and crude protein (CP) and energy digestibility coefficients (%). While, NW groups, on average, had significantly ($P<0.05$) higher hot carcass (%) and plasma cholesterol and urea than CW groups. Studied feed additives, on average, significantly affected plasma total lipids, urea and creatinine, and organic matter (OM), ether extract (EE), and crude fiber (CF) digestibility coefficients. There were significant treatment differences ($P<0.05$) for WG, FI, plasma glucose and urea and EE digestibility coefficients.

EFFECT OF TRIACYLGLYCEROLS OF CAPRYLIC AND CAPRIC ACID ON PERFORMANCE, MORTALITY AND DIGESTIBILITY OF NUTRIENTS IN GROWING RABBITS. SKŘIVANOVÁ V.^{*}, VOLEK Z.^{*}, ZITA L.^{*†}, MAROUNEK M.^{**} **Res.Inst. of Animal Prod., Prague 10, Cz Republic. †Czech Univ. of Agric. Prague, Cz Republic. **Inst. of Animal Physiology and Genetics, Czech Academy of Sci, Prague, Cz Republic. skrivanova.vera@vuzv.cz.*

Medium-chain fatty acids, as consequence of their antimicrobial activity, may represent an alternative to in-feed antibiotics. The aim of our study was to examine effects of an oil containing triacylglycerols of caprylic and capric acid on growth, mortality and digestibility of nutrients in growing rabbits. Akomed R (Karlshamns, Sweden) containing caprylic, capric and lauric acid at 60.8, 38.7 and 0.3 g per 100 g of fatty acid methylesters, respectively, was used. In a field experiment, 216 rabbits weaned at 35 days of age were divided into two groups and fed a pelleted feed supplemented with Akomed R at 0 or 10 g/kg till 11 weeks of age. Rabbits of both groups gained more than 40 g per day, on average. There was no effect of Akomed R on the rate of growth. Mortality of rabbits of the treated group (15.7%) was significantly lower than that of rabbits of the control group (27.8%). The second experiment was carried out in an animal facility of the Czech University of

Agriculture. Twenty rabbits (10 per group) were fed the same diets, with or without Akomed R. Digestibility measurements were performed in the 9th week of age. Digestibility of nutrients was not significantly affected. Carcass yield and feed conversion were not significantly different in treated and control rabbits. It can be concluded that medium-chain fatty acids supplied as triacylglycerols decreased high mortality of growing rabbits under field condition, but had no effect on other zootechnical parameters investigated.

EFFECT OF DIGESTIBLE FIBRE/STARCH RATIO AND ANIMAL FAT LEVEL IN DIETS AROUND WEANING ON MORTALITY RATE OF RABBITS.

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Ten experimental diets were formulated according a factorial design with 5 digestible fibre/starch ratios (0.75 - 0.84, 1.07 - 1.17, 1.57 - 1.66, 2.47 - 2.50 or 4.59 - 4.27, by replacing mainly wheat with beet pulp) and 2 levels of animal fat (3% or 6%). Four hundred young rabbits were fed on each diet from 17 to 42-day old and then switched to a commercial feed until 63-day old. Mortality rate along the trial was very high (40.7%) and diet-dependent. The digestible fibre/starch ratio had an effect on mortality rate: it decreased (45.8%, 45.4%, 39.4%, 38.0% and 35.0%, $P < 0.001$) as digestible fibre/starch ratio increased; this effect originates in 4th to 6th week period, when differences in mortality rate were much important (36.4%, 29.3%, 24.8%, 19.0% and 13.6%, $P < 0.001$). Moreover, the level of animal fat seems not affect total mortality rate but its distribution in the two considered periods: in 4th to 6th week period mortality rate was greater with the high-fat diets (26.5% vs. 22.8%, $P < 0.01$), the opposite occurring in 7th to 9th week period (19.4% vs. 23.2%, $P < 0.05$). According these results, in order to reduce the mortality rate, it seems advisable the inclusion of digestible fibre instead starch and not a noteworthy increase of the animal fat content in diets for rabbits

around weaning, but further research is necessary to develop adequate feeding programs to maintain the reduction on mortality during the rest of growing period.

ENERGY UTILIZATION AND PARTITION OF NULLIPAROUS RABBIT DOES IN THE LAST THIRD OF PREGNANCY.

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Thirty-two nulliparous rabbit does were mated with artificial insemination to determine the energy metabolism at the beginning of the last third of pregnancy. The animals were divided into two groups each of them fed one of two pelleted diets with different energy concentration (EC1: 11.7 MJ DE/kg DM; EC2: 11.1 MJ DE/kg DM) offered at two levels of intake: restricted (R, 35 g* $LW^{0.75}$) or *ad libitum* (AL). Individual apparent digestibility and metabolizability were determined on 4 days-period with individual metabolic cages; heat production and energy retention were computed by indirect calorimetry on twenty-four rabbit does. The digestibility coefficient and metabolizability of the energy of diet EC1 were higher than those of diet EC2 (63.5 vs. 59.6 and 61.2 vs. 56.4; $P < 0.001$) while no difference was registered between intake levels. Energy retention resulted lower in restricted animals (-31.4 vs. 79.3 kJ/ $LW^{0.75}$; $P < 0.01$) and not influenced by the energy concentration of the diet. In the body of rabbit does a significant loss of energy due to the mobilization of fat deposits was observed. Protein balance of the does (maternal plus conceptus tissues) was positively affected by AL intake; fat balances were almost always negative, especially in restricted animals. The relationship between RE and MEI was studied by a simple linear regression for each ingestion level; the ME requirement for maintenance was estimated to be 435 and 486 kJ/ $LW^{0.75}$ for AL and R, respectively. The efficiency of utilization of ME for growth was 0.58 in animals fed *ad libitum* but much higher (1.03) for the does fed at the restricted level of

intake as a consequence of their higher body fat mobilisation.

THE EFFECT OF RESTRICTION ON DIGESTIBILITY OF NUTRIENTS, ORGAN GROWTH AND BLOOD PICTURE IN BROILER RABBITS. TŮMOVÁ E.*[‡], SKŔIVANOVÁ V.[‡], ZITA L.*[‡], SKŔIVAN M.*[‡], FUĚÍKOVÁ A.*[‡] *Czech Univ. of Agriculture Prague, Cz. Republic. [‡]Res. Inst. of Animal Production, Prague, Cz. Republic. tumova@af.czu.cz.

The effect of quantitative restriction in growing rabbits on digestibility of nutrients, internal organs growth and blood picture was investigated in two experiments. Rabbits in experiment 1 were fed *ad libitum*, or restricted one week at the age 42 to 49 days (50 g of feed per day per rabbit), or restricted two weeks (50 g in the first week and 75 g of feed per day per rabbit in the second week) between 42 and 56 days of age. In the second experiment the restriction period was 2 weeks, between 42 and 56 days of age and the rabbits were divided in three groups. The group 1 was fed *ad libitum*, the rabbits in group 2 got 50 g at the age 42 to 49 days and 65 g of feed at the age 49 to 56 days and in group 3, 50 g and 75 g of feed at the two periods, respectively. Compensatory growth was recorded mainly in group restricted one week. Restriction decreased daily feed intake. The digestibility of nutrients significantly improved only in restriction period, in re-feeding period there were no differences between restricted and *ad libitum* fed rabbits. The organs growth was affected by restriction and re-feeding period. At the end of restriction we found higher share of heart and kidney. The liver and stomach significantly ($P<0.05$) increased their weight during re-feeding period. Most parameters of blood picture were not influenced by feeding regimens.

EFFECT OF A LIMITED ACCESS TO WATER ON WATER CONSUMPTION, FEED INTAKE AND GROWTH OF FATTENING RABBITS. VERDELHAN S., BOURDILLON A., MOREL-SAIVES A. *CYBELIA – Groupe Glon- 104, avenue du Président Kennedy – 75781 Paris cedex 16 - France.*

The aim of this trial was to study the effect of water restriction on feed intake for 336 rabbits

from 32 to 62 days of age. Rabbits were housed in cages of 7 rabbits. There was 4 treatments (12 cages per treatment) which differed only by the time of access to water. In the control group, the rabbits were given water *ad libitum*, in the 3 other groups, the rabbits were given water during 1h 30, 2h 30 or 4h per day at the end of the light period (4 pm). Water consumption decreased respectively to 62%, 72% and 87% of the *ad libitum* level (201 ml/day/rabbit). Feed intake decreased ($P<0.0001$) respectively to 78%, 83% and 87% of the *ad libitum* level (129 g/day/rabbit). Thus, a limited access to drinking water allowed to reproduce feed restriction. From 62 to 69 days of age, all rabbits were given water *ad libitum*. At slaughter, only rabbits with limited access to water during 1 h 30 from 32 to 62 days were significantly lighter than the rabbits of the control group, the weight difference was of 135 g ($P=0.031$).

REPLACEMENT OF STARCH BY PECTIN AND CHICORY INULIN IN THE STARTER DIET OF EARLY-WEANED RABBITS: EFFECT ON GROWTH, HEALTH STATUS, CAECAL TRAITS AND VISCOSITY OF THE SMALL INTESTINAL CONTENT. VOLEK Z.*[‡], SKŔIVANOVÁ V.*[‡], MAROUNEK M.*[‡], ZITA L.[‡] *Res. Inst. of Animal Prod., Prague, Cz. Republic. [‡]Inst. of Animal Physiology and Genetics, Cz. Academy of Sci. Prague, Cz. Republic. [‡]Czech Univ. of Agriculture in Prague, Cz Republic. volek.zdenek@vuzv.cz.

The aim of this study was to evaluate the effect of a higher level of dietary pectin or dietary pectin and inulin (Frutafit® IQ), as a partial replacement of starch, in the starter diet of early weaned rabbits on growth, health status, caecal traits and viscosity of the small intestinal content. A total of 180 (60/group) and 18 (6/group) early-weaned rabbits, 21 days old at the beginning of the experiment, were used for growth performance and intestinal traits evaluation, respectively. Three experimental diets were formulated: control diet, diet P (pectin) and diet PI (pectin+inulin). The control diet (19.0% ADF, 18.6% starch, 4.3% pectins) was fed to rabbits of the 1st group from weaning to slaughter (at the age of 77 days). Diets P (20.3% ADF, 12.5% starch, 9.0% pectins) and PI

(20.0% ADF, 10.3% starch, 9.0% pectins+4% inulin) were fed to rabbits of the respective group from weaning to 42 days of age, then rabbits received the control diet till slaughter. For the intestinal measurements, rabbits were slaughtered at the age of 42 days. Rabbits fed the control, P and PI diet gained on average 43.9, 44.6 and 45.0 g/d, respectively. Corresponding feed consumption per kg of gain was 3.84, 3.57 and 3.23 kg. For the whole fattening period (from 21 to 77 d), the lowest mortality was observed in rabbits fed the PI diet (25.0, 33.3 and 43.3 % in rabbits fed the PI, control and P diet, respectively, $P=0.10$). Total VFA concentration in the caecum of rabbits fed diet supplemented with inulin (PI diet) was significantly higher ($P=0.02$) and the pH significantly lower ($P<0.001$) than in the caecum of others rabbits. The viscosity of the small intestinal contents was higher in rabbits fed P and PI diet than in control rabbits ($P=0.10$). There were no significant differences in weights of digestive organs, except for the weight of stomach, which was the lowest in rabbits fed P diet ($P<0.01$).

EFFECT OF REPRODUCTIVE RHYTHM AND LITTER WEANING AGE ON THE PERFORMANCE AND BODY ENERGY BALANCE OF RABBIT DOES. XICCATO G.*, TROCINO A.*, SARTORI A.*, QUEAQUE P.I.*, BRECCIA G.†, BOITI C.† *Dpt. Sci. Zootec. Univ. of Padova. Legnaro. Italy. †Dpt. Sci. Biopatologiche Vet. Univ. of Perugia. Italy. gerolamo.xiccato@unipd.it.

One hundred twenty multiparous does were used. The does were synchronized to have parturition the same day (initial kindling). The trial lasted until the successive (final) kindling. At initial kindling, 22 does were selected for initial comparative slaughter. The remaining does were assigned to three reproductive rhythms, being mated 2 days *post-partum* (R2), 11 d *pp* (R11) or 26 d *pp* (R26). Within each rhythm, the does were further divided into two groups, whose litters were weaned at 21 (S21) or 25 (S25) d of age. A total of fifty-four does were pregnant and were slaughtered soon after the final kindling. *Effect of reproductive rhythm.* When increasing the kindling to mating interval, total

milk production increased (5590 to 6065 g for R2 and R26 rhythms; $P=0.05$). Voluntary feed intake was not affected during lactation (364 g/d on average), but decreased during the dry period (182 to 169 g/d; $P=0.05$) and throughout the entire experiment (299 to 249 g/d; $P<0.01$) according to reproductive rhythm. At the final kindling, the number of kits born per litter was lower in does submitted to R11 rhythm ($P<0.01$). When increasing the kindling to mating interval, doe body water concentration decreased, while fat and energy increased ($P<0.001$) and a higher EB gain was recorded (from -123 to -4 to 97 g, $P<0.001$). As a consequence, body protein, fat and energy balances moved from negative values to equilibrium as reproductive rhythm became extensive (energy balance: -14.4%, -1.8% and +0.5% of the initial body content in R2, R11 and R26 does, respectively; $P<0.001$). Blood leptin concentration at 28 d after kindling was higher in R26 does ($P<0.01$), indicating higher body fat recovery due to lack of pregnancy. *Effect of weaning age.* Daily feed intake during the entire experiment was significantly lower in W21 does due to the longer dry period. At the final kindling, increasing weaning age from 21 to 25 d, both the number of kits born alive per litter (from 7.3 to 9.8; $P=0.02$) and doe body water concentration increased, while body fat and energy decreased ($P<0.05$). Therefore, W21 does showed an energy balance near equilibrium (-2.6%) while W25 does had negative fat (-14.1%) and energy (-7.9%) balances ($P=0.08$). Lower blood leptin concentration was recorded in W21 than W25 does (1.87 vs. 2.76 ng/ml, $P=0.03$).

EFFECTS OF ENZYME ADDITION AND SOURCE OF FIBER ON GROWTH AND FIBROLYTIC ACTIVITIES OF GROWING-FINISHING RABBITS. FALCAO -E-CUNHA L., REIS J., FREIRE B.J., CASTRO-SOLLA L. *Inst. Sup. de Agronomia, Sec. de Produção Animal, Lisboa, Portugal. lfalcao@isa.utl.pt*

Four different diets were prepared, having a similar NDF and protein levels, with either alfalfa or corn cobs as source of fiber, and in each case with or without the commercial enzyme preparation Roxazyme G. Feeds were offered to

4 × 12 rabbits from weaning, at 28 days, until slaughter, at 70 days. Another 12 rabbits were slaughtered at weaning, so as to assess the fibrolytic activities of the cecal contents at this age. Caecotrophs were collected at 35 and 42 days, caecal contents samples at slaughter. Intakes were measured daily, live weights weekly. During the first week after weaning, enzyme addition only had a significant effect on cellulolytic activity ($P < 0.05$), which was 35% lower with the enzyme (43 vs. 58 mg of glucose $\text{h}^{-1} \text{g DM}^{-1}$). On the other hand, pectinolytic activity markedly increased, irrespective of enzyme addition, more in corn cobs than in alfalfa diets (in mg sugar $\text{h}^{-1} \text{g DM}^{-1}$, from 66 to 142, and from 66 to 103, respectively). Cellulolytic activity only increased when enzymes were not added, again irrespective of source of fiber: an increase of 65% in alfalfa diets ($P = 0.009$), of 55% in corn cobs diets ($P = 0.02$). At 42 days no effect was detected in any of the fibrolytic

activities under study. During the first week after weaning, enzyme addition did not affect performances, but FCR was lower with corn cobs than with alfalfa diets. In the following weeks, performances, both intake and FCR, were again only affected by source of fiber (from 42 to 72 days, daily intake in g and FCR were 177 and 4.21 in alfalfa diets, 141 and 3.49 in corn cobs diets, respectively). The fibrolytic activities measured at slaughter show no effect of enzyme addition or source of fiber, the exception being pectinolytic activity being higher in corn cobs than in alfalfa diets (82.5 vs. 72.5 mg sugar $\text{h}^{-1} \text{g DM}^{-1}$). Enzyme addition did not influence either the performances during the growing and finishing phases, nor the caecal bacterial activity, assessed through fibrolytic activities in caecal contents. The only exception was cellulolytic activity being reduced by the enzyme addition during the first week after weaning.

