Three experiments (123 digestive balances) were carried out to determine the digestibility of major nutrients (OM, CP, CF, fibre components) of several types of dehydrated lucerne pellets and to define the effect of their chemical composition on the energy value for rabbits. Twelve batches of lucerne differing by their protein (16 to 26% DM) and crude fibre content (19 to 31% DM) were tested. Digestibility measurements were performed with 49-day-old New Zealand White male rabbits (10 minimum per treatment) according to the European reference method including an adaptation period of 7 days followed by a 4 days collection period. Animals were fed *ad libitum* on diets containing 100% lucerne. Organic matter digestibility of the experimental diets decreased linearly ($P<0.01$) with cell wall content on the basis of 1.2 point per point of crude fibre (CF) in the dry matter. A close relationship was found between digestible energy (DE) value of lucerne and CF level, expressed by the following equation :

DE (MJ/kg DM) = 13.93 - 0.196 CF (%DM)

r=-0,91 ETR = 0.35 (3,9%) *(n=12).*

49 - PEREZ J.M., BOURDILLON A.*, JARRIN D*, LAMBOLEY B., LEBAS F., LE NAOUR J.**, WIDIEZ J.L.***

Determination of *in vivo* digestibility in rabbits with the European reference method : interlaboratory study

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 365-374.

INRA, Station de Recherches Cunicoles, BP 27, 31326 Castanet Tolosan Cedex (France)

* Sanders Aliments, BP 32, 91201 Athis-Mons Cedex (France)

** Guyomarc'h Nutrition Animale, BP 234, 56006 Vannes Cedex (France)

*** INRA, Unité Expérimentale Monogastriques, Le Magneraud, BP 52, 17700 Surgères (France)

A collaborative study was undertaken to assess the reproducibility of several methods for *in vivo* determination of digestibility in rabbits. For all the digestibility coefficients (dDM, dOM, dE, dCP, dCF, dNDF, dADF), and the energy digestible content, reproducibility was estimated from 4 diets measured in 4 laboratories by using their own procedure or the European reference method . On the whole, 312 digestive balances were carried out on the basis of 8 to 10 rabbits per diet for each method at the end of the experiments. A highly significant laboratory effect was observed with the own procedures mainly for the ED content which differed beetween the 4 laboratories. In comparison with the individual laboratory procedures, the reference method improved the reproducibility notably for the digestibility of dry matter (between-laboratories coefficient of variation = 2,4 *vs* 3,9%), organic matter (CV = 2,5 *vs* 4,5%), and crude protein (CV = 2,3 *vs* 4,1%).

50 - XICCATO G., COSSU M.E *, CARAZZOLO A., CARABAÑO R.** , RAMOS M.**

In vitro evaluation of the nutritive value of rabbit diets. Efficacy of different digestive enzymes.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 375-383.

Dipartimento di Scienze Zootecniche, Università di Padova (Italy)

* Departamento de Nutricion Animal, Universidad de Buenos Aires (Argentine)

** Departamento de Producción Animal, Universidad Politecnica de Madrid (Spain)

In order to validate in two laboratories an enzymatic method of *in vitro* digestibility of rabbit diets and evaluate the efficacy of different enzymes, 19 rabbit diets were analysed to determine the *in vitro* digestibility of organic matter (vMO). The analyses were performed by using Viscozyme enzyme on the same set of diets, both in Padua (V.PAD) and in Madrid (V.MAD). In addition, in Padua the efficacy of Viscozyme was compared to that of other enzymatic treatments performed during the 3rd phase of the reference method: Bio-Feed Plus, Energex or No-Enzyme (absence of enzyme). Multiple regression equations based on vMO and/or chemical composition of the diets were calculated by step-wise analysis, to estimate the *in vivo* nutritive value (digestibility of organic matter, dMO, and digestible energy content, ED). The reference method resulted to be suitable in the estimation both of dMO and DE ($R^2 = 0.71$-0.80; coefficient of residual variability - CVR = 2.6-3.2%), enabling to improve significantly the nutritive value estimation based on the chemical composition of the diets ($R^2 = 0.54$-0.58; CVR = 3.8-4.2%, using crude fibre or NDF as predictors). The two laboratories, although utilising the same method and enzyme (Viscozyme), obtained significantly different results, especially with the diets rich in fibre and poor in DE, and gave different regression equations ($P<0.05$). Comparing the different enzymes, Viscozyme (both in Padua and Madrid) and Energex resulted to be the best predictors of the nutritive value; on the contrary, Bio-Feed Plus and No-Enzyme were comparable in efficacy to the chemical data. The multiple regression equations based on *in vitro* and chemical analysis further increased ($P<0.05$) the precision of the estimate of the nutritive value ($R^2 = 0.77$-0.85; CVR = 2.4-3.0%).

MEAT QUALITY

51 - CABANES-ROIRON A., OUHAYOUN J.*

Influence of slaughter age on carcass and meat characteristics of rabbits slaughtered at the same live weight

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 385-391.

ITAVI, 28 rue du Rocher, 75008 Paris (France)

* INRA, Station de Recherches Cunicoles, BP 27, 31326 Castanet Tolosan Cedex (France)

Two rabbits groups from the same weaning group were slaughtered at 62 or 73 days at the same individual live weight (2.45 kg). Rabbits early reaching this weight (62 days) have better growth performance. But their slaughter characteristics (slaughter yield, meat to bone ratio and hindquarters cuts) are lower (eg. 53.2 vs 56.1 % for slaughter yield). pH level measured on 3 hind leg muscles is greater for 73 days old rabbits but slaughter age doesn't influence cooking losses. Sensory properties of the 2 groups are compared (hind leg and loin) and show some appearance and texture differences. Hypothesis of greater potential adult live weight of precocius rabbits (62 days) is discussed.

52 - CABANES-ROIRON A., OUHAYOUN J.*, GILBERT S.**

Rabbit meat quality : Influence of three storage treatments on microbial, physico-chemical and sensory properties.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 393-402.

ITAVI, 28 rue du Rocher, 75008 Paris (France)
* INRA, Station de Recherches Cunicoles, BP 27, 31326 Castanet Tolosan Cedex (France)
** ADIV, 2 rue Chappe, 63039 Clermont-Ferrand Cedex 2 (France)

Influence of storage length (2, 8 and 12 days), of his modalities applied 2 days after refrigeration (storage at +2°C ; cold rupture at +20°C during 30 mn then storage at +7°C ; freezing at -18°C) and of meat state (raw and cooked) on microbial, physico-chemical and sensory characteristics of rabbit meat is investigated. Meat stored at +2°C keeps good microbial properties during at least 8 days ; maturation induces pH increase, proteins denaturation, lipolysis, lipids peroxydation and meat luminosity increase. Cold rupture rapidly deteriorates meat sanitary quality and stimulates lipolysis. Freezing stops pH at his initial value, reduces maturation hydrolytic reactions and water holding capacity. Meat appearance, colour, flavour and texture differ between treatments. Freezing-thawing process deteriorates raw meat appearance and cooked meat texture.

53 - HADDAD B., MAERTENS L.*, DEMEYER D.**, UYTTERHAEGEN L.**

The buffering capacity of rabbit *longissimus dorsi* one hour Post-Mortem.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 403-408.

INAT, 43 Av. Charles Nicolle, 1082 Tunis (Tunisia)
* Rijksstation voor Kleinveeteelt, Burg., Van Gansberghelaan 92, 9820 Merelbeke (Belgium)
** Univ. Gent, Vakgroep Dierlijke Produktie, Proefhoevestraat 10-12, 9090 Melle (Belgium)

Three rabbits with an average slaughter weight of 2.8 kg were used to measure the buffering capacity of the *longissimus dorsi (LD)* one hour *post mortem*. Five grams of the LD muscle of each rabbit were homogenized in 25 ml distilled water. The variation of the pH was followed by adding each 10 min. 1 ml 0.1 N HCl or 0.1 N NaOH. The buffering capacity is expressed as the ratio between the variation of the pH to the quantity of added acid or base. The results demonstrated that the maximum buffering capacity of the LD was between a pH of 6.28 to 7.23 and minimal between a pH of 5.45 to 4.99. These values are higher than those reported for the LD of other species. Two LD samples of these rabbits were analyzed and compared with beef LD. Rabbits' LD showed a much higher non-protein nitrogen content compared to beef (0.224 *vs* 0.149 % fresh meat), which could explain the higher buffering capacity. The buffering capacity is further discussed related to literature data of other species.

54 - HADDAD B., MAERTENS L.*, DEMEYER D.**, UYTTERHAEGEN L.**

Post mortem changes of rabbit *longissimus dorsi* and meat quality as effected by the mode of chilling.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 409-417.

INAT, 43 Av. Charles Nicolle, 1082 Tunis (Tunisia)
* Rijksstation voor Kleinveeteelt, Burg., Van Gansberghelaan 92, 9820 Merelbeke (Belgium)
** Univ. Gent, Vakgroep Dierlijke Produktie, Proefhoevestraat 10-12, 9090 Melle (Belgium)

Four experiments were executed in order to study the sensibility of rabbits *longissimus dorsi* (LD) against cold shortening and the consequences on meat quality. In total 64, eleven to thirteen week old rabbits were slaughtered according to usual conditions, without pre-slaughtering treatment. In each experiment, the rabbits were divided in two homogeneous groups (sex, weight) and chilled immediately (RP) after slaughtering or after a 6 hours storage period at ambient temperature (RT). Chilling was performed at 2°C with an air speed of 2 m/s. *Post mortem* changes of temperature, pH, sarcomere length, drip losses and tenderness were followed in the LD. Initial values of pH were quite low (6.60 to 7.01), probably because of the rapid disappearance of the energetic potentials due to the slaughter technique. In spite of the rapid decline of the temperature in the heart of the muscle and the moderate decrease of the pH, favoured by the early chilling, no cold shortening was observed in the LD. Initial drip losses showed a large individual variation. The *post mortem* increase was proportional to the pH drop and in all cases independent of the mode of chilling. Very low shear force values were determined both after immediately chilling as after delayed chilling. The results are further discussed referring to data of other species.

55 - HERNANDEZ P., PLA M., BLASCO A.

Prediction equations on carcass quality of two lines of rabbit with different growth rate.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 419-425.

Departamento de Ciencia Animal. Universidad Politécncia de Valencia., P.O. Box 22012, Valencia 46071 (Spain)

120 carcasses of two synthetic rabbit lines were used in the experiment. Their adult weight was different (4 319 and 3 993 g) and so was the time to arrive to the commercial weight (8 and 9 weeks respectively). The animals were slaughtered between the limits of the Spanish commercial slaughter weight (1500 to 2 200 g). Carcass retail cuts and dissection were obtained according to the norms of the WRSA. Meat weight was easy to predict and was essentially determined by carcass weight. No retail cut on external measurement on the carcass gave a good prediction of the meat percentage of the reference carcass, meat/bone ratio or amount or proportion of dissectible fat. Perirenal or inguinal fat can predict the total amount of dissectible fat. To find a good prediction of the percentage of meat in the reference carcass it is necessary to dissect a leg. To predict the meat/bone ratio it is necessary to use the same ratio of the leg. The statistical model contains the interactions between line and coefficient of regression, but none of them were significant.

56 - KUITCHE A., DAUDIN J.D.

Calculation of the chilling of rabbit carcasses

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 427-434.

INRA, Station de Recherches sur la Viande, Unité Génie des Procédés, Theix 63122, St-Genès Champanelle (France)

A simple and quick method for the calculation of chilling kinetics of rabbit carcasses is proposed. This method was elaborated from the analytical solutions of the Fourier's equations related to the infinite cylinder. These equations were adapted to take into account the time-variations of the air properties, the evaporation of water at the surface of the product and of the complexity of the shape of a rabbit carcass. The user give the carcass weight and the chilling conditions and obtain the results in a text file ; the calculations last 30 to 50 seconds with a P.C. compatible niers computer.
With time-variable chilling conditions, similar to those observed in industrial chillers, the chilling time is predicted with a mean error of 6%, and the weight loss expressed in percent of the carcass weight is predicted with an error of 0.1% in absolute value.

57 - MASOERO G., DALLE ZOTTE A.*, PARIGI-BINI R.*, XICCATO G.*, BERGOGLIO G.

Utilization of near infrared spectroscopy (nirs) for the evaluation of carcass and meat quality of pre-slaughter transported rabbits.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 435-442.

Istituto Sperimentale per la Zootecnia Via Pianezza, 115 - 10151 Torino (Italy)
* Dipartimento di Scienze Zootecniche Università degli Studi, Via Gradenigo, 6 - 35131 Padova (Italy)

In order to evaluate the changes in the chemical composition, the physical and the sensory properties of meat from rabbits stressed by 2 h pre-slaughter transportation or unstressed, 60 animals were slaughtered at 3 different ages (77, 84 or 91 d). The *longissimus dorsi* (LD) muscle and the hindleg muscles (MP) were analysed by NIRS after drying and homogenization. A total of 36 measured variables were calibrated by the Modified Partial Least Squares method, with good results in terms of chemical variables, ultimate pH (average of 5 muscles) and lightness (average of 2 muscles). Sufficient results were obtained for shear force value, cooking losses and sensorial tenderness. Analyses with estimated data from NIRS equations confirmed almost all the significant differences linked to transport and age factors. The NIRS distinguished the meat of transported rabbits (R^2 of cross validation = 0.49 for LD and 0.53 for MP) and the type of muscle (R^2v=0.97), better than the multivariate analysis of real data for the type of muscle (R^2 of the model=0.86). The NIRS estimated the age of rabbits with a standard error of 2.5-3 d. The most significant wavelengths were the following: 1798 nm for the type of muscle; 1638 nm (LD) and 1938 nm (MP) for the slaughter age; 1938 nm (LD) and 1528 nm (MP) for the transportation.

58 - OUHAYOUN J., LEBAS F.

Effect of feed withdrawal, transport and waiting before slaughtering on dressing percentage and on muscle physico-chemical characteristics in the rabbit.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 443-448.

INRA, Station de Recherches Cunicoles, BP 27, 31326 Castanet Tolosan Cedex (France)

Two experiments were conducted to investigate the effect of feed withdrawal, transport and waiting before slaughtering on slaughter and muscle characteristics of rabbits. In the first experiment, 120 rabbits were assigned to one of four treatments: feed withdrawal 41 h (F41), 24 h (F24) or 17 h (F17) before slaughter or *ad libitum* fed control (C). In the second experiment, 200 rabbits were assigned to an experimental design including the effects of two distances of transport (T^-: 30 km or T^+: 250 km) and two waiting durations before slaughtering (A^-: 30 min or A^+: 18 h). Slaughtering percentage (reference live weight measured at the beginning of feed withdrawal) was equally lowered in F41, F24 and F17 (57.1 to 58.3 %) group compared to control group (60.3 %). On the other hand, these treatments had the advantage to reduce the weight of transported rabbits from the breeding unit to the slaughter house (6 to 8%) and the amount of offal (17%). Slaughtering percentage (reference live weight measured in the farm) was equally reduced in T^-A^+, T^+A^- and T^+A^+ groups, compared to T^-A^- group. The ultimate pH of muscle was increased by feed withdrawal and, particularly, by transportation; on the other hand, the brightness of muscle was lowered by these treatments. Waiting before slaughter slightly reduced the effects of transportation on muscle characteristics.

MANAGEMENT

59 - COLIN M., LEBAS F.*

Rabbit meat production and consumption in the world. A synthesis attempt.

6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 449-458.

Ralston Purina Europe, BP 301, 78054 St Quentin en Yvelines Cedex (France)
* INRA, Station de Recherches Cunicoles, BP 27, 31326 Castanet Tolosan Cedex (France)

Following previous publications, a study was carried out in order to estimate the quantitative importance of production and consumption of rabbit meat in each of the world countries, and to determine their main characteristics. This study was based on different types of information such as official statistics, scientific publications, accounts of trips, public or private economical information, surveys, etc. Secondly, a synthesis was done so as to determine the main characteristics of rabbit meat production and consumption in the world. The estimated world rabbit meat production was 1.6 million of tonnes produced by 70 million rabbit does. So, the average yearly production of a rabbit doe was 23 kg of carcass. On the basis on 3.3 US$ per kg of carcass (international price of frozen rabbit meat), the world value of the rabbit production was 5.3 billions US$, i.e. 0.025% of the whole world GDP.
This world production evaluation leads to a strong revaluation of rabbit meat production in most countries. The differences between the actual evaluation and the previous ones are due to previous frequent underestimating of traditional production and self-consumption in many countries. Our method reveal large rabbit meat productions in countries that are rarely taken into consideration in previous studies: Ukraine, Indonesia, Nigeria, Bielorussia. Based on all this, commercial oriented rabbit meat production and self-