

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.

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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 slaughterage; 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.

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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.

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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 reevaluation 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, Bielorrussia. Based on all this, commercial oriented rabbit meat production and self-

consumption oriented production have more or less the same importance at the international level. Finally, it appears that taking into account only the quantity of rabbit meat produced, does not enable us to know the real importance of rabbit production in each country. This can only be done by considering certain criteria such as the proportion of GDP represented by rabbit meat production and/or rabbit meat consumption per inhabitant.

**60 - CONTERA C., ALEGRE M., HERNANDEZ H., LINARES F., MARQUEZ R., COLIN M.\***

**The setting up of a rabbit sperm production organization and distribution in Spain.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 459-466.*

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This work deals with the results of fertility obtained by a Spanish A.I. organization. The semen used for this work comes from 16 production centers widely distributed across Spain. A.I. was carried out by the farmers themselves after a 3 day training period. The average fertility obtained was 71.3% and consequently very close to average fertility obtained by natural mating. Nulliparous does had higher fertility (+ 11%) than the other females while the fertility by insemination following a first negative insemination was only 61.7%. For the nulliparous, fertility was higher when the sperm was used on the farm where it has been produced than when it was brought in external farms but this difference was small and did not exist for the other does. Finally, despite the very high summer temperatures, the results of the South of the country was not different of those obtained in other regions.

**61 - GOBY J.P., ROCHON J.J.**

**A comparison between breeding results obtained in 2 different housing conditions : a closed system and an open air system in the south of France (Roussillon).**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 467-472.*

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In an economic context increasingly difficult, meat rabbit producers are trying to reduce production costs, for example by reducing their initial investments. At the Perpignan IUT, comparative trials have been made between an open air maternity and a closed system maternity. The technical results of the 2 systems analysed for 2 periods (autumn- winter; spring-summer) demonstrated that:

- mortality, from birth to weaning, is significantly lower in the open air in winter with a rate of 4.7%, but the rate increases in spring and with the arrival of hot weather becomes equal to the mortality rate observed in the closed system (18%),

- prolificity in the open air was significantly higher in spring (11.22 total born compared to 9.96 in a closed system).

This analysis shows that in Roussillon with an investment of 800 Francs per cage/reproductive female, an open air system for reproduction and meat production can give results equal or superior to a closed system.

**62 - KOEHL P.F.**

**Evolution of the technical performance observed between 1991 and 1993 in the same group of 526 rabbit breeding units.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 473-480.*

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Since 1983, ITAVI publishes a compilation of the annual production data of rabbit producers which have adopted in France a system of technical & economical recording (RENALAP). But the renewal of the RENALAP participants is about 25% per year. So it is necessary to verify if the evolution of the performance observed year after year is the consequence of the renewal (disappearance of producers with bad economical results) or is also observed in a constant group of producers. So the author has analysed the results of 526 breeding units observed during 3 consecutive years (1991 to 1993) and corresponding to 56% of the initial units observed for RENALAP in 1991. The evolution of the constant sample is close to that of RENALAP. Nevertheless, fertility and prolificity increase from 1991 to 1993 in a lesser extent in the constant group than in RENALAP: +1.6% vs +4% and +0.17 vs +0.36 rabbits born/litter respectively. The number of rabbits produced (sold) /doe and /year was higher in the constant group than in RENALAP in 1991 (47.5 vs 45.5) but quite the same in 1993 (46.8 and 47.1). Inside of the constant group, the does to mother-cage ratio explains 17% to 50% of the productivity per mother-cage variations from one year to the other. The post-weaning mortality explains 16% to 30% of these variations. At least, 32% of the producers have difficulties to maintain their productivity level during the 3 years of observation. They were 25% only 5 years ago.

**63 - KOEHL P.F.**

**Comparison of rabbit breeding units with low or high productivity per doe.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 481-485.*

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

The author compared the production conditions of two groups of breeding units from the 1100 French rabbit breeding units under technical & economical control (years 91 and 92). For the low productivity group (L), the criteria was less than 43.5 young rabbits produced (sold) per doe and per year, n=50 units. The criteria was more than 53 young rabbits per doe and per year for the high productivity group (H), n=97 units. All the technical results were better in the H group : proportion of fertile matings 80.0% vs 67.2%, young born per litter 9.5 vs 8.6, birth to weaning mortality 15% vs 22.5%, weaning to slaughter age mortality 9.0% vs 18.7%. In the H group, 84% of the does were commercial «hybrids», but only 32% in the L group. The utilization of special diets for weaning (before and after) was the normal situation in 87% of the H units, but only 58% in the L units. The does average production life from first mating to elimination (or death), was 10.1 month in the H group and only 8.75 month in the L one. For 38% of the H units, rabbit production was the only work of the breeder, vs 16% in the L group.

64 - KOEHL P.F.

**First production results of rabbit units managed with only one reproduction group.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 487-490.*  
ITAVI, 28 rue du Rocher, 75008 Paris (France)

The author presents the production results observed in 17 units managed, mainly during 1993 and the first month of 1994, with only one group of does (reproduction every 35 or 42 days). The average productivity was not really different from that observed with the French recording system RENALAP in 1993 (1100 breeding units): fertility 72.9 vs 75.5%, litters /doe & /year 7.01 vs 7.14, total born /litter 9.56 vs 9.33, number of young rabbits produced /doe & /year 50.1 vs 47.1. The variability of the mortality rate was high within breeding units and between series. It was also high between units.

65 - KOEHL P.F., BOUVAREL I.

**Investigation into production conditions of French rabbit production units. Relations with technical performance.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 491-498*  
ITAVI, 28 rue du Rocher, 75008 Paris (France)

An investigation was realized into 473 meat rabbit production units during 1992. Sixty percent of the units employed commercial hybrids does, obtained mainly from «grand-parents» raised inside of the unit. The proportion was 84% for the males. The minimum theoretical delay between a kindling and the next presentation of a doe to a male was 8 to 11 days in 62% of the units, and shorter for all the others. All the does were kept inside of a building, but in 40% of the units the young were fattened (until 2.34 kg) in complete or partial open air conditions. During the last 10 years, the initial investment per mother-cage decreased from 2124 F down to 1553 F (F = French francs, basis 1991). For 37% of the producers, rabbit production was the main activity. No significant relation was observed between the productivity results of one unit and the level of its investment or the its level of specialization. Raising outdoor from weaning to slaughter age has no significant effect on the fattening period performance. On the other hand, this study has demonstrated the practical advantage of the hybrid does when compared to purebred + mixed origin does : fertility 76.1% vs 70.5%, young born /litter 9.22 vs 8.83, total birth to weaning mortality 18.2% vs 21.5%, total unit feed conversion ratio 3.90 vs 4.06.

66 - LE NORMAND B., JEGO P.\*, MAICHE N.\*

**Controlled suckling : interest in rabbit's breeding management.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 499-504.*  
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Two groups of does (1046 kindlings) are raised under controlled suckling (mother's access to the nest box only once a day during 15 mn) or under free suckling. The two methods are compared in relation with birth-weaning mortality and litter weight, in 7 breeding units were birth-weaning mortality is 10.28 %.

Mortality from birth to 10 days (suspension of controlled suckling) is significantly lower with controlled (5.41 %) suckling than free suckling (6.81 %), but the tendency reverse between 11 days and weaning. Global results show equal global performances between the two groups for litter weight and birth-weaning mortality.

67 - MIRABITO L., GALLIOT P., SOUCHET C.

**Effect of a regrouping of rabbit does before artificial insemination on the reproductive performance**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 505-509.*  
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326 artificial inseminations (AI) were realised from the 06/28/1993 to the 05/25/1994. Three does were gathered together before AI in a cage while three others were inseminated as soon as they went out of their cage. The average duration of the regrouping was 6.0 minutes.

The treatment has no effect on the fertility (82.5 %) or the prolificity (10.5 rabbits born alive by litter).

68 - MIRABITO L., GALLIOT P., SOUCHET C., BOLLENGIER J.

**Effect of a lighting program and of limited duration of acces to the feed on the growth performance and feed conversion of fattening rabbits.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 511-519.*  
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1901 rabbits were controled from weaning (32-34 days) to slaughter age (73 days). Half of the animals were raised from weaning to 48 days old under 16L/8D lighting treatment (7H00 - 23H00) and from 48 to 73 days old under 12L/12D (7H00 - 19H00) lighting treatment. The other half was raised in a dark room, except for care and feeding. When the rabbits were 48 days old, half of them, in the two groups, were allowed to eat only during 12 hours per day (19H00 - 07H00) while the others were fed *ad libitum*.

The mortality rate was not modified by the treatments (average : 10.8 %). The daily growth rate was decreased by the limited duration of acces to the pellets (42.7 g/d vs 43.8g/d); but the lighting duration has no effect on the average daily gain. The most important result of this study is that the average feed conversion ratio was significantly reduced by one combination of the two parameters : lighting + feed restriction (3.16 vs 3.27 to 3.34).

69 - LE RUYET P., JARRIND.\*, ROUILLERE H.\*, BOUSSEAU S.\*\*,  
DELHOMME G.\*\*

**Elaboration of a AI equipment for does artificial insemination in back position. Influence of equipment and depth of insemination.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 521-528.*  
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The aim of this work was to study a new one-use A.I. equipment as efficient as glass pipette. The first two trials showed the importance

of back position of the doe and the sperm laying depth in the female genital tract : a depth of 23-25 cm reduces the litter size of 0.93 total born young in comparison with 18 cm. We then achieved the comparison between the glass pipette and a bent pistol with a 5.7 mm diameter tube. The comparison was performed in a experimental facility on 380 A.I. and in 4 rabbit farms on 949 A.I.. The bent pistol and the glass pipette got the same fertility rate in the experimental facility (0.81 and 0.78 %, NS) and in rabbit farms (0.68 and 0.64 %, NS) but tended to decrease by 0.4 rabbits the litter size at birth ( $P < 0.10$ ). Finally, two depths of sperm laying in the female tract (15 vs 19-21 cm) were tested with the bent pistol in the experimental facility on multiparous does inseminated 10 days *post partum*. The A.I. at 15 cm tended to rise the fertility (+6 points,  $P < 0.10$ ) and the litter size (+ 0.8 rabbits,  $P < 0.10$ ). Thus that work reached its goal, even more it showed the importance to limit by 15 cm the depth of insemination.

70 - PAVOIS V., LE NAOUR J., DUCEP O.\*, PERRIN G.\*, DUPERRAY J.

**A natural method to improve the receptivity and the fertility of the lactating doe in artificial insemination**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 529-538.*

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The artificial insemination of the doe must overcome the problem of receptivity of the animals and above all of the lactating ones. The purpose of this study is to induce the receptivity among these inseminated does, 10 days *post-partum*, in separating them from their litters. The effect of a doe from young separation by closing the nest box access during 24 or 36 hours before insemination has been checked on :

- receptivity of the does and their reproductive performances,
- viability of the young rabbits which have been separated from their mother,
- weight gain of the young rabbits to which one suckling has been withdrawn (36 hours separation).

The results of the trials are in favour of separating the litters from their mother. Whatever the closing is, it permits to increase of 24 % the does receptivity and the fertility is more than 10 % better (68.3 vs 54.9 and 75.5 vs 64.4 in the 2 trials). Only the effect of the withdrawal of one suckling on the weight gain of the young rabbits must be checked.

71 - THEBAULT R.G., VRILLON J.L., ROCHAMBEAU H. de\*

**Artificial insemination in the "Rex du magneraud" strain. Comparison of two techniques.**

*6èmes Journées de la Recherche Cunicole en France, INRA-ITAVI, La Rochelle 6-7 déc. 1994, 539-544.*

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A comparison of two artificial insemination techniques has been done on a 80 females herd belonging to one " Rex du Magneraud " strain (Castor Rex). The trial was followed during 48 weeks with an

alternance of the two techniques every 6 weeks (4 repetitions). The first technique used plastic straws for unique use, the female in a lordosis position on her feet ; the second technique used glass bent pipettes, the female hold on her back.

This second technique produced better results in the comparison on fertility rate (76% vs 69%), and on the litter size total born (6.42 vs 6.02). Results for one artificial insemination (combination of fertility rate and prolificacy) were respectively of 4.13 total born young rabbits for the first technique and 4.85 for the second one.