Recent Advances in World Rabbit Technology

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Abstract

The analysis of the recent tendencies in rabbit production and technology was established in relation to about 270 congress communications and articles published in 1998 and 1999. Communications were mainly presented during the 7th French Rabbit days (Lyon France - May 1998), the 1st Rabbit Conference of the Americas (Mexico - September 1998), the 2nd International Conference on Rabbit Production in Hot Climates (Adana - Turkey, September 1998), the 11th Symposium on housing and diseases of rabbit, furbearing animals and pets animals (Celle - Germany, May 1999), the 11th Hungarian conference on rabbit production (Kaposvar, May 1999) and the 8th French Rabbit days (Paris - France , June 1999). Articles were mainly those published in World Rabbit Science, the journal of the WRSA but also in technical European rabbit journals.

The first remark concerns the subjects of the communications or articles : about 1/4 are devoted to rabbit nutrition and feeding, 21% to reproduction control; 15% are specialised on genetics and selection but only 10% are devoted to pathology, 9% to meat quality and 12% to management and rabbit production economy. Ultimately it must be emphasised that 4% of the papers are devoted to rabbit "welfare" and behaviour.

Subjects on genetics and selection are dedicated mainly the quantitative improvement of rabbit production (number of kits, growth rate) by utilisation of crossbred rabbits, but the number of criteria considered at this occasion increased (associated response to selection of other criteria). One part is also devoted to knowledge of old traditional European breeds and to adaptation of European selected rabbit lines in other countries and environmental conditions.

Studies on rabbit reproduction are mainly devoted to rabbits does bred under a " single band" system with artificial insemination, *i.e.* all does of the same rearing unit (building, ...) inseminated every 42 days (or 35 days). Research and technical efforts are made to improve the low results (mainly low % of kindling) observed after insemination of lactating does. The methods studied concern PMSG utilisation and more recently utilisation of bio-stimulators such as temporary mother-litter separation or bringing does together just before insemination. For the first time in 1996, the average productivity of French breeding units managed under the "band" technique with artificial insemination (180 000 breeding does under official control) produced more rabbits per doe and per year than more traditional units with natural mating once a week or more frequently (245 000 breeding does under control) : 50.0 *vs* 49,1 ready-to-slaughter rabbits produced per doe and per year.

Pathology subjects are mainly devoted to enteritis and pasteurellosis control. A lot of work is made on Contagious Rabbit Enterocolitis; but, if the practical consequences (mortality and morbidity) can be correctly controlled with antibiotics, up to now,the infectious agent has not be isolated and no specific prevention or treatment methodology can be proposed. Nevertheless, at this occasion the general hygienic prevention methods including all the rabbitry management, have proved their great efficiency.

Studies on nutrition are dedicated to various subjects : feeding of the pregnant-and-lactating does, nutrients requirement of growing rabbits, nutritive value of various raw materials, etc. New tables on nutritive value of the most common European feeds were published.

Studies on meat quality are now included as a "normal" part of the results of studies on genetic, nutrition or management systems. Meat quality is studied on the basis of the chemical and dietetic composition, but also on the basis of technological parameters and sensory evaluation of the cooked meat.

Publications on management can be classified in 2 categories - 1 - description of complete management systems employed in different regions or countries, and - 2 - comparison of different variants of one part of a rabbit unit management, *i.e*. feeders length per young, density in cages during fattening, reproduction control (see above), type of housing (dimension of cage and type building), temperature control and response to heat stress, etc.

New studies on rabbit welfare are mainly devoted to the number of rabbits per cage (for breeding as during fattening period), to the dimension of cages (surface available per rabbit, height of the cage) or type of floor. Surprisingly, growing rabbits prefer a (good) wire mesh floor and neglect the straw litter if they have choice: more than 80% of the rabbits are observed on the wire mesh part of the pens (1.6 m²) and growth rate of rabbit with free choice was reduced by 10% when compared to rabbits reared in the same pens with only wire mesh floor (44,0 *vs* 44.5 /day).

INTRODUCTION

Since the past two years, a lot of congress communications and new articles were published in relation with rabbit production. The recent tendencies in rabbit production and technology were then established after analysis of about 270 communications and articles published in 1998 and 1999. Communications were mainly presented during the 7th French Rabbit days (Lyon France - May 1998), the 1st Rabbit Conference of the Americas (Mexico - September 1998), the 2nd International Conference on Rabbit Production in Hot Climates (Adana - Turkey, September 1998), the 11th Symposium on housing and diseases of rabbit, furbearing animals and pets animals (Celle - Germany, May 1999), the 11th Hungarian conference on rabbit production (Kaposvar, May 1999) and the 8th French Rabbit days (Paris - France , June 1999). Articles were mainly those published in World Rabbit Science, the journal of the WRSA but also in some technical European rabbit journals. On table 1, number of papers published at each occasion are presented.

***Table 1** : Number of communications on rabbit production published at different main occasions and employed to analyse the recent tendencies*

Congress or Journal	Number of Communications or Articles	Main language
Lyon (France) 13-14 May 1998	57	French
Mexico (Mexico)7-11 September 1998	32	English/Spanish
Adana (Turquey7-9 September 1998	32	English
Celle (Germany) 19-20 May 1999	27	German
Kaposvar (Hungary) 26 May 1999	21	Hungarian
Paris (France) 9-10 June 1999	41	French
Articles in WRS journal 1998	30	English
Article in WRS journal 1999	22	English
TOTAL	**262**	

The first remark concerns the subjects of the communications or articles as presented in table 2 : about 1/4 are devoted to rabbit nutrition and feeding, 21% to reproduction control; 15% are specialised on genetics and selection but only 10% are devoted to pathology, 9% to meat quality and 12% to management and rabbit production economy. Ultimately it must be underlined that 4% of the papers are devoted to rabbit "welfare" and behaviour. Authors of theses papers are working mainly in Europe, but also in Americas (North and South), in Africa, in West and South Asia, but none in China. It the reason why it's for me a real pleasure to participate in the present congress of the Chinese branch of the World Rabbit Science Association. It gives me the opportunity to increase largely my knowledge on "rabbit research world".

***Table 2 :** Main subjects of the communications an articles*

Main subjects	Genetics & Selection	Reproduction & Breeding	Nutrition & Feeding	Pathology & Hygiene	Welfare & Behaviour	Growth & Meat	Management & Economy
Lyon 1998	9	13	18	9	1	5	1
Mexico 98	6	5	9	2	0	2	8
Adana 1998	4	9	11	2	0	2	4
Celle 1999	6	4	5	4	5	0	3
Kaposvar 99	2	6	7	0	1	4	1
Paris 1999	10	4	4	7	4	5	6
WRS 1998	1	12	4	2	0	3	6
WRS 1999	2	3	2	0	0	2	3
TOTAL	**40**	**56**	**60**	**26**	**11**	**23**	**32**
% of total	*15.3%*	*21.4%*	*22.9%*	*9.9%*	*4,2%*	*8,8%*	*12.2%*

The object of this communication is not to summarize all the above mentioned papers, but only to make a tentative of extraction of some "new" tendencies in the different areas of rabbit research. These tendencies are classified according to the headings of table 2.

Independently of the themes, a new tendency must be underlined : the increasing number of research works make in international co-operation. These collaborations are organised in informal groups for nutrition in the EGRAN group (Gidenne, 1999) and for reproduction in the IRRG group (Boiti, 1998) or is the result of personal relations of researchers of different countries, mainly in Europe but also between researchers of different parts of the world.

RECENT ADVANCES IN GENETICS AND SELECTION

In selection, the tendency is to increase the number of criteria taken in account beside the main object of selection. Two examples are given on table 3. In the French works (Brun *et al*, 1999; Theau-Clément *et al*, 1999; Bolet *et al.,* 1999) the objective was to select on number of kits born alive per litter, a synthetic line employed as paternal side of a commercial crossbred doe. Many criteria in relation to reproduction were added, but also some criteria in relation to growth rate Similarly, in Spain Gomez *et al*. (1998, 1999) include e.g. litter size at slaughter age in addition to the main criterion of selection on litter size at weaning. The objective is generally to control that the biological answer to selection does not create negative side aspects. This idea is not new, but the increase of the number of criteria is new.

***Table 3** : Examples of criteria taken in account in addition to the main object of selection*

Authors	Main object of selection	Additional Criteria taken in account
Brun *et al*, 1999 Theau-Clément *et al*, 1999 Bolet *et al.,* 1999	Litter size at **kindling** in a new synthetic grand-parental line	**Does** Adult weight , % of receptivity, % of fertility, number of ovum after ovulation, % implanted embryos, number of total born kits, litter size at weaning **Males** % of useful sperm collection, motility of sperm, pH and volume of ejaculate, % of ejaculated with high mortality, percentage of live spermatozoa, spz concentration **Kits** individual weight at weaning and at 63 days, weaning to slaughter growth rate,
Gomez *et al*., 1998 Gomez *et al*., 1999	Litters size at **weaning**	**Does** litter size at kindling (total and alive), litter size at slaughter age (60 d.) **Kits** individual weight at weaning and at 60 days, weaning to slaughter growth rate and fed conversion ratio (average and evolution with age)

In the same way of increasing knowledge of biological parameter associated to selection, Gomez *et al*. (1999) have compared during one year reproduction performance of the same 2 lines in 4 different experimental raising conditions (i.e. 4 rabbitries). The very interesting result is that significant differences may be observed in some conditions but not in some others as illustrated in figure 1 and 2 for litter size at kindling and at weaning.

***Table 1** : Total number of kits born per litter for the same 2 lines, in 4 different Spanish breeding units (according to Gomez* et al*., 1999)*

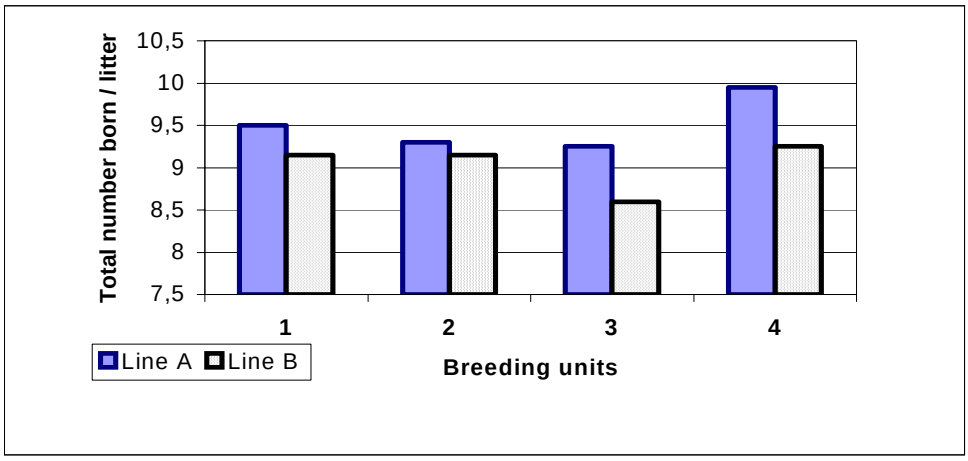
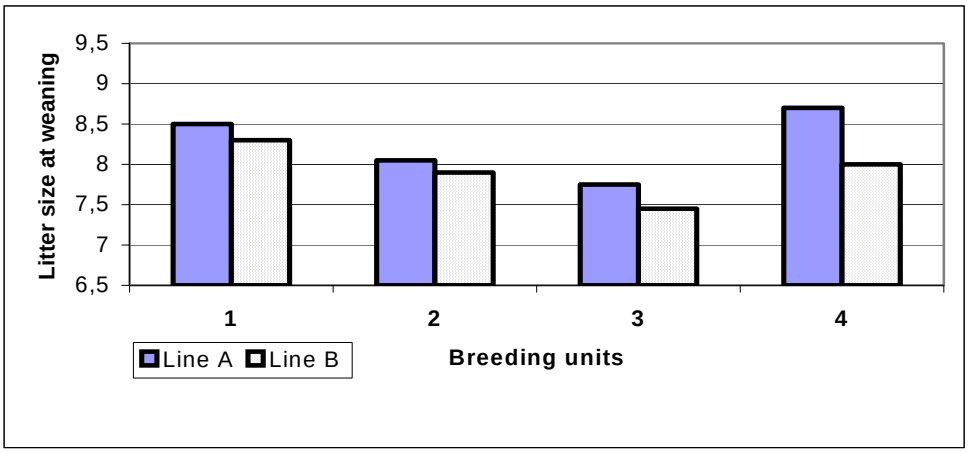


***Table 2** : Total number of kits weaned per litter for the same 2 lines, in 4 different Spanish breeding units (according to Gomez* et al., *1999)*



There is also a new tendency to compare performance of European selected lines to "local" lines or breeds in different environmental conditions, generally hot conditions. As illustrated by by Testik *et al*. (1999), absolute values of performance may be widely reduced in hot conditions, but generally lines classification order is not modified. It means that in quite all conditions the better line remains the better, but differences may be very small if environmental conditions (climates, feeding, ….) are not optimum for the better line. Nevertheless, if adaptation of the animals is not complete (the best is born and reared in the test conditions) the results of one line may be impaired (Kpodekon et al., 1998) as illustrated on table 4.

Table 4 : Example of interaction between adaptation to tropical conditions and growth performance from 31 to 87 days in 2 lines of rabbits (according to Kpodekon et al*., 1998)*

Line origin [(1)]	**Local**	**French**	**Local**	**French**
Feeding conditions	**Local meal** [(2)]	**Local meal**	**Pellets** [(2)]	**Pellets**
Dry matter digestibility (%)	76.8a	74.2a	68.8b	68.0b
Average growth rate (g/ day)	23.4b	19.4c	28.5a	29.6a
Feed conversion ratio (as DM)	3.09a	2.65b	2.97a	2.76b

(1) Rabbits of the African local line were born in the rabbitry (i.e. adapted to climate and food) and the French rabbits, a New Zealand White line, were born in France and fostered in Africa after air transportation at the age of 2 days (i.e. bad adaptation to climate and local food)

(2) Local meal was manufactured in the breeding unit with local ingredients, and pellets were imported from France for the experiment.

The last tendency may be described as an increasing interest for the genetic and phenotypic evaluation of old traditional breeds. The consequence is a description of "old" breeds such as the French "Normand" (Koehl and Van der Horst, 1998), the Italian "Carmagnola grey" (Lazzaroni et al., 1999) or the "Tax-Xiber" the indigenous rabbit from Malta (Gauci-Maistre, 1999). In the same time, a computerised data bank is under development in Europe and around the Mediterranean sea for centralisation of controlled information on breeds characteristics (Ducourouble *et al,* 1999). In addition A cryobank was establish for conservation of frozen sperm and embryos of the endangered breeds or selected rabbit lines (Joly & Renard, 1998).

RECENT ADVANCES IN REPRODUCTION AND BREEDING

For reproduction the clear new tendency is the generalisation of artificial insemination as a normal reproduction technique. The effort is made mainly to improve fertility of lactating rabbit does inseminated 3-4 or 10-11 days after kindling (Theau-Clément and Boiti, 1998). Effectively in the same time, in commercial breeding units can be observed a great increase of the "band" technique, i.e. all does inseminated on the same day every 35 or 42 days without re-insemination of unfertile does. This technique implies the insemination of lactating does with low rates of receptivity and fertility (kindling rate) as indicated in table 5

***Table 5** : Sexual receptivity and fertility rate of rabbit does submitted to artificial insemination according to the physiological stage (Castellini* et al., *1998)*

Does physiological situation	Sexual receptivity (%)	Fertility rate (%)
Nulliparous	67.4	79.2
Primiparous lactating	55.3	40.2
Primiparous NON lactating	63.5	80.0
Multiparous lactating	67.1	46.7
Multiparous NON lactating	67.0	70.5

At beginning of the 90's, this improvement was easily obtained with a PMSG treatment 48 days before insemination (8 to 25 IU per doe). But this treatment implies hormones utilisation and such situation is badly accepted by the public opinion. Then, other alternative methodologies called "bio-stimulations" were tested. A single doe-litter separation 24 to 48 hours before artificial insemination (i.e. one or two omitted nursings) has been extensively studied with good reproduction results (table 6). But young weaning weight was systematically reduced in relation with quantitative and qualitative alteration of doe milk production (Theau-Clément and Mercier, 1999, Szendrö et al., 1999)

***Table 6 :** Effect of a 24 h doe-litter separation on reproductive performance of lactating does and young weaning weight (Theau-Clément and Mercier, 1999,).*

Controlled criteria	24 h separation	Control group
Sexual receptivity (%)	60.7	53.2
Fertility rate (% kindling)	**94.9a**	**82.3b**
Born alive per litter	10.1	9.3
Weaned per kindling	8.6	8.4
Average kits individual weaning weight (g)	559a	593b

An additional way to improve fertility rate may be the gathering of breeding does just before insemination : independently of their physiological status groups of 8 does were placed in a cage (0.40m²) during 15 min just before artificial insemination (Duperray et al;, 1999). Kindling rate was

improved for lactating does (86.5 *vs* 81.1%) as for non lactating ones (85.0 *vs* 77.4% for the control). If fertility rate was significantly improved in both physiological situations, size and weight of the litter were not modified at kindling (table 7). Gathered lactating does as control lactating does were separated from their litter during 36 hours before insemination.

This technique seems promising, but it must be emphasised that there is only one publication. It must be added that in 1994 Mirabito *et al.,* have not observed any significant improvement of kindling rate after gathering does also just before insemination by groups of 3 during 6 minutes, but without doe-litter separation for lactating does (82.9 *vs* 82.1% for the control on average).

***Table 7** : Effect of does gathering in groups of 8 for 15 min just before artificial insemination, on fertility and kindling characteristics (Duperray et al., 1999).*

Controlled criteria	Gathering 15 min	Control
Kindling rate (%)	86.0a	79.9b
Kits born alive per litter	10.31	10.40
Average litter weight (g)	653	657
Average individual kits weight (g)	59.8	60.3

Note : all lactating does were previously separated from their litters during 36 hours

An other tendency in reproduction studies is also the increasing interest in relations between kits and their mother. As mentioned above, if one suckling is missing the development of the young is impaired. On the contrary if the young can benefit of 2 does with one suckling in the morning and the second one 12 hours later in the evening (Gyarmati *et al.,* 1999), the average milk intake is increased by 74% and individual kits weight at weaning (35 d.) is increased by 27% (1,07 *vs* 0.84 kg). The advantage of double suckling until weaning remains at slaughter age (70 days) : 2.91 *vs* 2.49 kg without variation of slaughter rate of proportion of cuts except a higher quantity of kidney+scapular fat (42 *vs* 29 g). These results indicate that never the young's milk intake capacity is a limiting factor of growth rate during the suckling period in practical conditions (only one doe). Then it is important to increase doe's milk production because of the benefit for growth rate of slaughter rabbits. On the contrary such increase of milk intake has only a slight effect on reproduction ability of young does since individual birth weight seems influence this ability more than the milk intake monitored through number of young per litter (Poigner *et al*., 1999).

RECENT ADVANCES IN NUTRITION AND FEEDING

The first point to be emphasised in the nutrition field is the publication a book on rabbit nutrition published by De Blas and Wiseman (1998). The 17 chapters were written by a total 24 European contributors. It was the occasion to publish new tables for feeds composition and nutritive value for rabbits These tables as published in the 7th French Rabbit days in Lyon (May 1998) are presented in the following three parts of table 8 (Perez *et al*., 1998). The interest of digestible energy values included in these tables has been increased since Perez *et al* (1999) have clearly demonstrated that digestibility (of energy and other nutrients) is not influenced by genetic origin of growing rabbits in a study with 10 commercial and experimental rabbit lines.

In other fields new trends are studies on "new" amino acids such as threonine (Campos-Hernandez, 1999 a,b). At this occasion, the authors explain this interest of AA recommendations based on (faecal) digestible amino acids rather than on crude values : 0.44% digestible threonine in diet for breeding does and 0.40% for growing are the optimum values (0.64 and 0.60% respectively when expressed as crude threonine).

An other tendency is the increase consideration for mineral nutrition, mainly phosphorus (Lebas et al., 1998; Maertens, 1999). This is in relation with European new rules on soils minerals pollution, mainly phosphorus. The results is the "discovery" that lower phosphorus levels such as 0.3% to 0.4% of diet are as suitable as the previous recommendations of 0.6-0.7% (table 9).

Table 9 : *Effect of dietary phosphorus level on growth (30-71 d.) and slaughter performance of fattening rabbits (Lebas* et al*, 1998).*

Phosphorus level (% diet as fed)	**0.30**	**0.39**	**0.48**	**0.57**	**0.66**
Daily growth rate (g/d)	33.9	34.8	33.7	34.2	34.0
Feed conversion ratio	2.93	2.88	2.82	2.92	2.75
Slaughter rate (%)	58.5	58.9	58.6	58.9	58.0
Femur length (cm)	78.9[a]	-	78.6[a]	-	76.6[b]
Femur mechanical resistance (N)	221	-	224	-	234

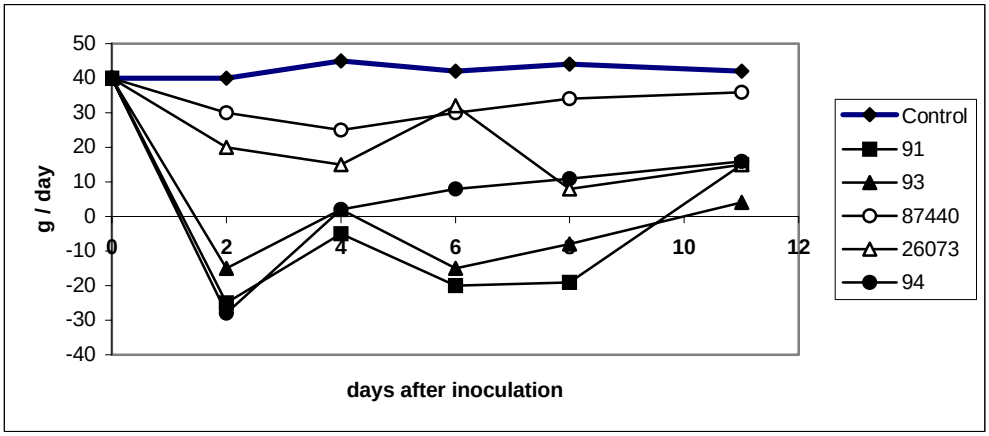
In addition to the previous tendencies, researchers on rabbit nutrition continue to study the interest of many raw ingredients for inclusion in complete diets such as alfalfa (Perez, 1998; Perez *et al*., 1998; Fernandez-Carmona *et al*., 1998), or less classical products such as neem (*Azadirachata indica*) seed kernel cake (Wasanthakumar *et al.,* 1999) or date pits (Aboul-Ela *et al*., 1999). Some other works are more devoted to evaluation of complete diets made with local ingredients (Berchiche *et al*;, 1999).

Many other papers are also devoted to evaluation of nutrients requirements in different biological, environmental or climatic conditions, but it cannot be considered as a "new" tendency.

RECENT ADVANCES IN PATHOLOGY AND HYGIENE

First of all it must be emphasised that only few research are published in this sector (see table 2). New tendency in France is to study the "new" Rabbit Epizootic Enterocolitis (REE), but only few scientific papers were published, one about the disease reproduction (Licois *et al*., 1998) and one resuming the research effort and first results (Licois and Coudert, 1999). In addition, some papers describe the evolution of the disease in France and Europe (Lebas *et al*., 1998 a,b; Rossi *et al*, 1999) and efficiency of zinc-bacitracine to arrest apparent consequences of REE (Duperray, 1999).

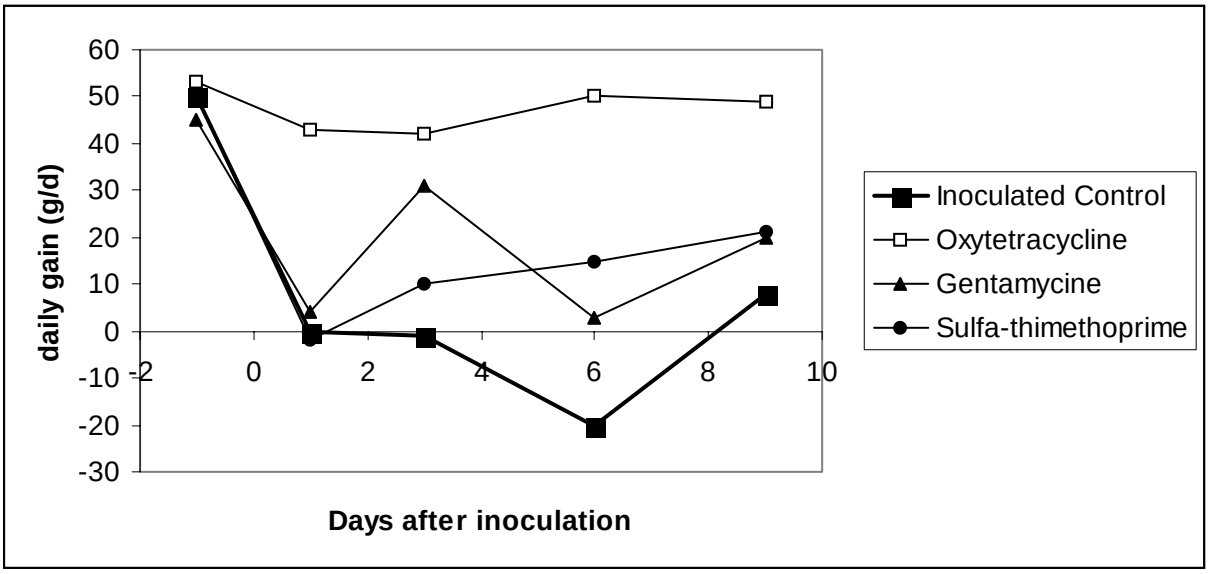
Figure 3 : Evolution of daily growth of young rabbit after intradermal inoculation of 5 strains of Pasteurella multocida *(according to Coudert* et al*., 1999).*



Some other works are devoted to studies on *Pasteurella multocida* (Coudert *et al*., 1999; Werckentin et al., 1999). The main result is that according to the pasteurella strain and to the route of infection, consequences can be completely different (figure 3). It means that without strain identification, isolation of some *Pasteurella multocida* is deprived of signification.

The symptoms and lesions are essentially respiratory tract disease and/or forms involving abscesses of the skin, mammary gland, middle ear or uterus. In fattening rabbits, *Pasteurella* as origin of enteritis is rarely described and diagnosed, but is probably more common than is believed. Even if experimental antibio-therapy can be efficient during a short time (figure 4; Rideau *et al.,* 1998), treatment of pasteurellosis with antibiotics is extremely disappointing because recurrence is more or less systematic. In commercial breeding units, such treatment should be recommended only if very strict hygiene and prophylactic measures are put in place at the same time. Vaccinations - auto vaccinations exclusively - can be performed only for reproducers and should be used in addition to strict hygiene measures and prophylaxis.

***Figure 4** : Evolution of daily weight gain of 30d. old rabbits after intradermal inoculation of a* Pasteurella multocida *strain, according to the antibiotic treatment (Rideau et al., 1998)*
(The Pm strain was isolated from cutaneous abscess in a rabbitry with frequent abscess and high mortality; *in vitro* the Pm strain was sensible to Gentamycine, Tetracycline and Trimethoprime but resistant to Sulfadoxine)



A last new tendency in the pathology area is the observation of the increase of *Salmonella* infection in commercial rabbitries (Agnoletti *et al.,* 1999). Ten years ago, salmonellosis was described exclusively after contamination of rabbit by other animals (ducks, turkeys, …) reared in the immediate vicinity of the rabbitry. In the present time, salmonellosis seems to be an emergent pathology and a true disease of rabbits.

RECENT ADVANCES IN WELFARE AND BEHAVIOUR

The research effort in the area of rabbit welfare is mainly related to cages dimension and type of soil. Some researcher helped by the public opinion consider caging of rabbits as a very high constraint. For this reason many works compared rabbits reared in cages or in pens. The constant result is that in large pens daily growth rate is reduced : e.g. reduction of 14.6% of the final weight of rabbits reared from 36 to 86 days in large pens (8.0 m² for 64 rabbits) compared to litter mates reared in cage (0.44 m² for 7 rabbits) as demonstrated in table 10 (Van der Horst *et al*., 1999).

For breeding does, quite all assays of group breeding (2 to 10 does in the same pen) have conclude that adult rabbit does must be reared individually. The surface of the cage (from 0.30 to 0.60 m² / doe + nestbox) , its height (35 to 60 cm) or the number of levels (cages with one or two floors) were investigated. All these parameters have only few influence on breeding does productivity or behaviour pattern (Rommers and Meijerhof, 1998; Mirabito *et al*., 1999).

***Table 10** : Effect of rearing rabbits in pens or in cage on growth performance from 36 to 86 days old (Van der Horst et al., 1999).*

Housing type	CAGES	PENS
Surface	0.44 m²	8 m²
Number of rabbits per cage	7	64
Initials weight (g)	953	968
Final weight (g)	2668a	2276b
Feed conversion ratio	4.47a	5.34b
Mortality	14.8	18.2

The quality of the floor was also largely investigated. If the quality of wire mesh floor is correct (wire ∅ > 2.5 mm) no differences in productive performance were observed for breeding does when compared to "alternative improved floor" (Rommers and Meijerhof, 1998). In a study with groups of 24 fattening rabbits reared in 1.6 m² pens, Morisse *et al.* (1999) have compared pens with wire mesh floor and pens with one half of the floor as in the previous ones and one half of the floor covered with 15 cm of barley straw. Surprisingly, growing rabbits preferred the wire mesh floor and neglect the straw litter if they have choice: more than 80% of the rabbits were observed on the wire mesh part of the pens and growth rate of rabbit with free choice was reduced by 10% when compared to rabbits reared in the same pens with only wire mesh floor (table 11).

***Table 11 :** Growth performance of fattening rabbits reared from 32 to73 days in pens with 2 types of floor : exclusively wire mesh or mixed floor made by half wire mesh and half straw litter (according to Morisse et al. ,1999)*

Type of floor	Wire mesh	Mixed
Initial weight (g)	707	703
Final weight (g)	2535a	2330b
Slaughter rate (%)	56.0	56.8
Average daily growth (g/day)	44.5a	40.0b
Feed conversion ratio	3.1	3.1
% time in 1st part of the pen (wire mesh) [1]	44.4a	82.8b
% time in 2nd part (wire mesh / straw)	55.6c	17.2d

[1] : feeder were in the first part of the pens covered in all cases with wire mesh floor

RECENT ADVANCE IN GROWTH AND MEAT

In the studies devoted to rabbits growth and quality of meat, a new trend is the attempt to estimate *in vivo* the body composition of rabbits. Good results may be obtained with Magnetic Resonance Imaging (Körver *et al*., 1998) or X Ray Computer Tomography (Romvari *et al*., 1996) but the cost of such determination is very high and equipment is not available for most of researchers but for the group working in Kapovar (Hungary). Determination of body composition by Total Body Electric Conductivity (TOBEC) is less expensive; it seems suitable for determination of breeding does composition (Fortun Lamothe et al., 1999), but unsuitable for newborn rabbits (Milisits et al., 1999). The main reason of this difference in efficiency, seems directly related to variability of proportion of fat : great in adult does and smaller in new-born rabbits.

The other trend in meat quality studies is the introduction of sensory tests to measure at the end point the "qualitative" value of the meat for human consumption (Juin et al, 1998; Jehl et Juin, 1999). In the same time, physico-chemical methods are developed to propose some acceptable

substitutes to sensory methods because of the difficulty to manage a great number ofsensory tests per day (Delmas et al., 1999; Xiccato et al., 1999).

RECENT TRENDS IN MANAGEMENT AND ECONOMY

In management of rabbitries the recent trend is the achievement of the development of the "bande unique" in commercial rabbitries i.e. all does are inseminated the same day, 30-31 days after all the pregnant does kindle together, all litters are weaned on the same day and all rabbits leave the rabbitry on the same day for the slaughter house. In most cases does are re-inseminated 10-11 days after kindling; i.e. exactly 42 days after the previous insemination, in, some others the interval between 2 consecutive inseminations is only 35 days. The average year productivity of rabbitries is now similar for units managed as "bande unique" with artificial insemination or managed with natural mating practised according to possibilities of the does (table 12).

***Table 12** : Average productivity of French rabbitries (natural mating and "bande unique") and of Spanish ones (all types together) for the year 1996 (Guerder, 1999 a, b; Ramon et al., 1999)*

	France		**Spain**
	Natural mating	**Bande unique**	**Mixed**
Number of rabbitries	797	482	388
Number of does under control	243 673	195 210	172 890
Number of does/ male	10.5	-	-
% replacement of does /year	126 %	117%	126%
Interval 2 kindlings / doe (days)	52.6	54.6	51.7
% kindling / mating or Artif. Insemin.	77.9	75.8	75.0
Kits total born / litter	9.90	10.11	9.16
Kits weaned / litter	7.90	8.25	7.47
Rabbits slaughtered /doe - year	49.1	50.0	49.7
Live weight ready for slaughter (kg)	2.41	2.40	1.96
Rabbitry feed conversion ratio (kg/kg)	3.83	3.67	3.91
Birth-Weaning mortality (%)	19.8%	18.4%	14.1%
Weaning-Slaughter age mortality (%)	11.3%	9.6%	6.3%

In France, results for the year 1997 were reduced by 5to 8% in compared to year 1996, because of the development of the epizootic enterocolitis (Guerder 1999 a, b).

In addition to this general trends, research work were conducted on different points of rabbitry management e.g. feeders length per young, density in cages during fattening, reproduction control (see above), type of housing (dimension of cage and type building), temperature control and response to heat stress, etc. Many of these points were developed above; this type of research may be illustrated for example by the work of Szendrö et al. (1999) on the effects of heat stress on lactating rabbit does (table 13)

***Table 13**: Results of feed intake and milk production of rabbit does maintained at different temperatures (Szendrö et al, 1999)*

Temperature	**5°C**	**15°C**	**23°C**	**30°C**	**15°C**	**15°C**
Feeding level	**Ad lib.**	**Ad lib.**	**Ad lib.**	**Ad lib.**	**Restr.1**	**Restr.2**
Daily feed intake (g:d))	289	278	261	185	261	185
Daily water intake (g/d)	505	521	536	435	494	434

Water / Feed ratio	1.91	2.02	1.99	2.53	1.89	2.34
Milk production (g.day)	159	161	161	114	173	119

Ad lib. = ad libitum ;
Restr.1 = adjustment on spontaneous intake at 23°C;
Restr.2 = adjustment on spontaneous intake at 30°C

It appears from these results that elevated temperature (23°C is hot for a rabbit doe) primarily reduce feed intake and this reduction explains the main part of the reduction of milk production. Nevertheless for the same feed intake, milk production remain slightly reduced by high temperature.

CONCLUSION ON RECENT TRENDS

It is quite impossible to propose a conclusion for such over view of recent works published in the World. I hope only that it was a good open window on some parts of the rabbit world, for all the congress attendants.

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