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EFFECT OF GENOTYPE AND ENVIRONMENTAL TEMPERATURE ON THE PERFORMANCE OF THE YOUNG MEAT RABBIT

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SUMMARY : 31, 35 and 36 male New Zealand White (NZW), or commercial hybrids Hyla (H) and Provisal (P) rabbits were studied respectively, and reared until they were 85 days old. The test provided for two experiments: the first was carried out in winter (December - January) at an average temperature of 11°C and a relative humidity level approximately of 66 %, and the second in summer (July - August) at a temperature of 27°C and humidity level of 74 %. During the two trials the animals were fed "*ad libitum*" with a commercial pelleted feed. At the end of the study, 10 animals from each genetic group and for each season were slaughtered and jointed. As regards the effect of the genotype on growth performance, daily weight gain (32.8 g), intake (126.5 g/d) and feed efficiency (3.85 g/g) appeared similar for the three breeds considered. As regards seasonal effects, the high summer temperatures led to a significant reduction (P<.01) in daily live weight gain (29.5 *vs* 36.1 g/d), daily intake (102.6 *vs* 152.3 g/d) and feed efficiency (3.48 *vs* 4.22 g/g). Going on to consider the slaughtering data according to the genotypes, significant differences were observed with regard to the head and neck which appeared heavier in the purebred rabbits (11.16 *vs* 10.86 %, P<.05) than in the H whereas the P were intermediate (10.98 %). The commercial crossbreds provided significantly higher percentages (P<.01) with regard to the distal hind legs (2.47 *vs* 2.13 %) and empty stomach and guts (5.40 *vs* 5.24 %) compared to the purebred rabbits. As regards the seasons, breeding in summer led to a lower incidence on empty body weight of heart (0.39 *vs* 0.49 %, P<.01), liver (3.90 *vs* 4.24 %, P<.05), kidneys (0.59 vs 0.79 %, P<.01) and empty stomach and guts (5.18 vs 5.51 %, P<.01) and a higher warm carcass (65.64 *vs* 64.82 %, P<.05). Examination of the carcass jointing data indicated a smaller head and neck for the H rabbits compared to the NZW (13.14 *vs* 13.98 %, P<.01) with the P falling in the middle of the range (13.55 %). The percentage values for rumps, nates and thighs were lower (P<.05) in the purebreds than in the hybrids (33.06 vs 33.79 %). No significant differences were recorded between genotypes, but for the animals reared in summer there was a significantly lower amount (P<.01) of perirenal fat (1.62 *vs* 2.63 %), perivisceral fat (2.46 *vs* 3.54 %) and scapular fat (0.68 *vs* 0.92 %).

RESUME : Effet du génotype et de la température ambiante sur les performances du jeune lapin de chair.
Cette étude comporte deux périodes expérimentales : la première en hiver (Décembre - Janvier) à une température moyenne de 11°C et à un taux d'humidité relative d'environ 66 %, et la seconde en été (Juillet - Août) à une température moyenne de 27°C et un taux d'humidité de 74 %. Au total, 31, 35 et 36 lapins mâles Neo-Zélandais Blancs (NZW), ou croisés commerciaux Hyla (H) et Provisal (P) respectivement, ont été élevés jusqu'à 85 jours d'âge. Durant les deux périodes expérimentales les animaux ont été nourris ad libitum *avec un aliment granulé du commerce. En fin d'expérience, à chacune des saisons, 10 animaux de chaque groupe génétique ont été sacrifiés et disséqués. En ce qui concerne l'effet du génotype sur les performances de croissance, le gain de poids journalier (32,8g), l'ingéré journalier (126.5g/j) et l'efficacité alimentaire (3,85g/g) se révèlent identiques pour les trois génotypes considérés. En ce qui concerne l'effet de la saison, les températures élevées de l'été amènent une diminution significative (P<0.01) du gain de poids journalier (29,5 vs 36,1g/j) de l'ingéré journalier (102,6 vs 152,3g/j) et de l'efficacité alimentaire (3,48 vs 4,22g/j). Si l'on considère les résultats de l'abattage par rapport aux génotypes, des différences significatives ont été enregistrées concernant la tête et le cou qui se révèlent plus lourd chez les lapins de race pure (11,16 vs 10,86 %, P<0,05) que chez les lapins Hyla, tandis que les lapins Provisal se situent au milieu (10,98 %). Les lapins croisés commerciaux donnent des pourcentages significativement plus élévé (P<0,01), en ce qui concerne la patte arrière (2,47 vs 2,13 %), l'estomac et l'intestin vides (5,40 vs 5,24 %), que les lapins de race pure. En ce qui concerne l'effet de la saison, l'été semble avoir une incidence, en proportion du poids vif vide, sur le coeur (0,39 vs 0,49 %), le foie (3,90 vs 4,24 %, P<0,05) les reins (0,59 vs 0,79 %, P<0,01) et l'estomac et l'intestin vides (5,18 vs 5,51 %, P<0.01) et sur la carcasse chaude (65,64 vs 64,82 %, P<0.05). Les données provenant de la dissection de la carcasse indiquent que la tête et le cou sont plus petits (13,14 %, P<0,01) chez les lapins Hyla, moyen chez les Provisal (13,55 %) comparés au Néozélandais Blancs (13,98 %). La proportion de membre postérieur est plus faible (P<0,05) pour la race pure que pour les croisés commerciaux (33,06* vs *33,79 %). Il n'y a pas de différence d'adiposité entre les 3 types génétiques. Par contre, en été les lapins ont des proportions plus faibles (P<0,01) de gras périrénal (1,62* vs *2,63 %), de gras périviscéral (2,46* vs *3,54 %) et de gras interscapulaire (0,68* vs *0,92 %).*

INTRODUCTION

On the basis of data recently published by French authors (LEBAS and COLIN , 1992), Italian production of rabbit meat is higher than official estimates, reaching approximately 300,000 t equivalent to 24 % of world production. Consumption of rabbit meat has, in our country, progressively increased reaching about 4.0 kg per inhabitant per year, overtaking the consumption of lamb and goat (1.8 kg/inhabitant/year) and horse meat (1.3 kg/inhabitant/year) (UNA, 1992).

Undoubtedly one of the most important technical changes that has taken place in recent years concerns the genotypes. The purebreds, New Zealand

White and California, have been progressively replaced by crossbred commercial type rabbits.

Despite this trend, few experiments have been carried out to compare the performance of crossbred commercial type rabbits with that of purebreds (BELGIUM AGRICULTURAL CENTER, 1984; OKERMAN *et al.*, 1987; CHIERICATO and FILOTTO, 1989; RISTIC and ZIMMERMANN , 1992).

In northern Italy, where most national production takes place, there are considerable differences of rearing temperatures between winter and summer which can reach and exceed, for long breeding periods, 10° and 27°C respectively.

It is therefore important to study the behaviour of genotypes bred in different climatic conditions and in particular with regard to temperature.

For a better understanding of the above factors, researches have been carried out on both meat production and reproductive activity, at the Department of Animal Science at the University of Padova.

This study is an initial contribution and deals with meat production.

MATERIALS AND METHODS

Two experiments have been carried out, one in winter (December – January) and the other in summer (July – August).

Table 1. Feed composition

	%
Dehydrated lucerne meal	36.30
Wheat middlings	16.00
Soybean meal	8.00
Sunflower meal	6.00
Barley meal	19.00
Dried beet pulp	6.00
Molasses	3.60
Fat	1.00
Dicalcium phosphate	0.80
Calcium carbonate	0.80
Salt	0.50
Dl–methionine	1.00
Supplement	1.00

Supplementation per Kg of diet: vit.A I.U. 22000; vit.D_3 I.U. 2000; vit.E mg50; vit.B_1 mg6;vit.B_2 mg12; vit.B_6 mg13; vit.B_{12} mg 0.03; vit.K_3 mg6; vit.PP mg70; D-calcium pantothenate mg30; choline cloride mg1500; Mn mg80; Cu mg35; Zn mg100; Fe mg90; Co mg3; J mg1.5; robenidine mg60.

Table 2 : Chemical composition and nutritive value of feed (means ± S.D.)

Dry matter 89.00 %	% d.m.
Crude protein (Nx6,25)	19.01±0.29
Ether extract	4.20±0.33
Ash	7.80±0.31
N–free extract	52.79±1.91
Crude fiber	16.20±0.50
NDF	30.56±2.01
ADF	19.98±0.81
Calcium	1.07±0.18
Phosphorus	0.71±0.15
Magnesium	0.28±0.04
Potassium	1.54±0.09
Gross energy (kcal/kg d.m.)	4459
MJ/kg d.m.	18.65
Digestible energy (kcal/kg d.m.)	2858
MJ/kg d.m.	11.96
Metabolizable energy (Kcal/kg d.m.)	2697
MJ/kg d.m.	11.28

Animals and feeding

18 and 13, 21 and 14, 19 and 17 male New Zealand White (NZW), Hyla (H) and Provisal (P) rabbits were used in summer and winter, respectively. The last two genotypes were four–way crossbred commercial type rabbits. The purebreds came from a firm belonging to Italian Breeders Association, whereas the crossbreds originated from farms recommended by the firms that had produced the grandparents.

The subjects were selected on at least 10 litters per genotype and the characteristics of the breeding farms were all similar.

The rabbits were reared from 43 days old to 85 days old. The animals were fed *ad libitum* with a pelleted feed chemicaly analysed (A.O.A.C., 1970 ; MARTILLOTTI *et al.*, 1987) to determine the concentrations of gross, digestible and metabolizable energy (PARIGI BINI and DALLE RIVE, 1977). The feed (table 1 and 2) had a commercial type formulation and was in good accordance with nutritional requirements (CHEEKE et al., 1982 ; I.N.R.A., 1989).

Rearing and environmental conditions

The rabbits were housed individually in a Californian battery–cage system, the air diffusion within the building was obtained by forced ventilation of the outside air; there were no air heating or cooling systems. The temperature and air humidity were

Table 3 : Temperature and relative humidity observed during the two different seasons (means ± S.D.)

Temperature (°C)	SUMMER	WINTER
from 0 to 8 h	24.2 ± 1.4	10.6 ± 0.9
from 9 to 16 h	27.8 ± 2.5	11.8 ± 0.7
from 17 to 24 h	27.8 ± 2.6	10.8 ± 0.8
from 0 to 24 h	26.6 ± 2.8	11.1 ± 0.9
Relative humidity (%)		
from 0 to 8 h	81.3 ± 5.7	68.5 ± 3.7
from 9 to 16 h	69.2 ± 9.4	62.0 ± 3.9
from 17 to 24 h	71.9 ± 7.7	66.8 ± 3.3
from 0 to 24 h	74.2 ± 9.7	65.8 ± 4.6

continuously recorded by means of thermohygrograph (TIG – 1TH, L.S.I.).

From table 3 it can be seen that the mean temperatures are, in winter, relatively constant and low, reaching on average 11.1 ± 0.9°C. This temperature is considered normal in winter in non-heated breeding centres in northern Italy.

The ambient temperatures of this experiment are below the thermal neutrality and therefore able to induce stress to the animals. Relative humidity is between 62 and 69% and is considered suitable for meat production.

During the summer experiment, between 9 h and 24 h, the level of temperature was high : on average 28°C. SAMOGGIA (1987) observes that above 25°C production performance is affected. With regard to humidity, at the hottest time of the day it reached 70% and during the coldest part of the night, 81 % : both values, not relatively high, do not seem to exercise negative effects on the rabbits tested.

The photoperiod was 8 hours of darkness and 16 hours of light, provided by fluorescent lamps; the light intensity was 30±4 lux, controlled every five days by means of silicon sensor luxmeter HD 8366 (Delta Ohm).

Concentrations of ammonia in the environment remained within suitable levels for intensive rabbit rearing (3-8 ppm); they were measured by means of Dräger pump and kits.

Experimental controls

Food intake and health state of the rabbits were controlled daily and live weight was recorded every seven days.

At the end of the experiment , 10 animals for each genotype and each season were killed and bled by severing the carotid arteries and jugular veins and then skinned. The weight of the pelt (whole skin), the head and neck, separated by cutting through the seventh cervical vertebra and the first thoracic vertebra, and the weight of distal fore and hind legs with pelt, removed by dissection through the antebrachio–carpal and tibio–tarsal joints, were recorded.

Weights of the stomach and guts (full and empty), heart, liver and kidneys, perirenal, perivisceral and scapular fat were recorded.

The head and neck were then cut, without pelt, separated as above. The shoulders and fore legs were separated from the trunk by sectioning, around the shoulders, the caudal border of the triceps brachii muscle and cutting the pectoral and the trapezius and rhomboideus muscles. Two other cross sections, one cranial along the caudal edge of the last rib and the other caudal, following a vertical line on the tuber coxal, were used to separate the three joints of thoracic cage, loins and flanks and rump, nates and thighs. Since this trial had also practical aim, it was impossible to follow the procedure proposed by BLASCO *et al.* (1992); therefore we adopted the methodology used in italian slaughter–houses.

Statistics

All the data obtained were analysed by variance analysis, using the HARVEY package (1987), according to the following pattern:

$$Y_{ijk} = \mu + G_i + S_j + (GS)_{ij} + e_{ijk}$$

where:

Y_{ijk} = experimental data
μ = overall mean
G_i = fixed effect of i-nth genotype (i = 1,2,3)
S_j = fixed effect of j-nth season (j = 1, 2)
$(GS)_{ij}$ = effect of interaction
e_{ijk} = residual random effect (0, σ)

RESULTS AND DISCUSSION

Growth performance

As no important interaction effects between the genotypes and seasons were recorded, the tables present only the main effects of the treatments. The absence of interaction effects indicates that the genetic improvement allowed to obtain similar genotypes with equal capacity of adaptation to the different environmental temperatures.

Table 4. Average live weight, daily gain and feed efficiency.

	GENOTYPES			SEASONS		Error mean
	NZW	H	P	Summer	Winter	square*
Animals	31	35	36	58	44	
Initial live weight (g)	1119Aa	1287Bb	1221Bb	1247B	1170A	8281
Final live weight (g)	2455a	2687b	2619b	2488A	2686B	31470
Daily live weight gain (g)	31.8	33.3	33.3	29.5A	36.1B	15.47
Daily intake (g)	125.3	128.0	126.3	102.6A	152.3B	198.68
Feed efficiency (g/g)	3.94	3.82	3.78	3.48A	4.22B	0.1300

*: 96 degrees of freedom ; A, B: P<0.01; a, b: P<0.05

At the same initial age the purebred rabbits weighed 1119 g, 12 % less than the two crossbred genotypes which averaged 1254 g (table 4). This weight difference in the young rabbits at the same age is due, as shown by an experiment not yet published (CHIERICATO and RIZZI, 1993), to the performances of the mothers and youngs during the weaning period.

Rabbits belonging to genotypes H and P had a growth rate not significantly different from that of the purebred rabbits (33.3 vs 31.8 g/d). A very limited number of experiments have been performed on comparison between the considered genotypes. Our results, however, appear to be similar to those obtained in research carried out in Belgium (Belgium Agricultural Center, 1984) and in a previous experiment we had carried out (CHIERICATO and FILOTTO, 1989).
Intake also appears to be very similar: feed efficiency therefore shows no significant difference: 3.94 g/g in the purebreds and 3.80 g/g in the two commercial crossbreds. These results confirmed previous published data (BELGIUM AGRICULTURAL CENTER, 1984; OKERMAN *et al.*, 1987; CHIERICATO and FILOTTO, 1989).

Considering the effect of the seasons, from the table 4 it emerges that the average initial live weight was significantly lower in the winter than in the summer (1170 vs 1247 g, P<0.01). In absence of specific experimental observations it can be assumed as stated by HULOT and MATHERON (1980), that summer embryo mortality is higher and implantation rate is lower than in the other seasons of the year, so litter size is lower. Suckling rabbits in smaller litter can eat more milk than those of the larger one, so the weight of weaning rabbits may be higher in summer than in winter.

The average daily weight gain was significantly higher in the winter than in the summer (36.1 vs 29.5 g, P<0.01). This increased growth can be attributed to higher food intake observed in the rabbits reared in winter (152.3 vs 102.6 g/d, P<0.01). Consequently feed efficiency was more favourable in animals reared in summer (3.48 vs 4.22 g/g, P <0.01). The effects of the temperature observed in this study are in accordance with those obtained by us in previous laboratory experiments (CHIERICATO *et al.*, 1992) and with those observed by other authors (STEPHAN, 1981 ; LEBAS and OUHAYOUN, 1987 ; SIMPLICIO *et al.*, 1988).

During the trial no particular diseases were observed. With regard to the mortality, no significant difference was noticed among the experimental factors: the values varied from 3 to 5 %.

Slaughtering and jointing performance

With regard to the genotypes, table 5 shows that the head and neck were heavier (P<0.05) in the purebreds (11.16 %) than in the H (10.86 %), whereas the P (10.98 %) were intermediate. The hind legs were heavier (P<0.01) for rabbits P (2.49 %) and H (2.45 %) than to the purebreds (2.13 %). The proportion of empty stomach and guts is also significantly (P<0.01) lower for the NZW purebreds (5.24 %) compared to the H (5.42 %) and P (5.38 %).

The values given in table 5 also show that no differences were observed for the other parameters considered. In particular the warm carcass percentage was the same in all the three genotypes examined : on average 65.23 %. These results confirm those obtained in previous studies (OKERMAN *et al.*, 1987; CHIERICATO and FILOTTO, 1989).

As regards the effect of the season (table 5), in summer the percentage of the warm carcass was significantly higher than in winter (65.64 *vs* 64.82 %, P<0.05). This difference is the result of a number of lower percentages obtained during the summer period related to the heart (0.39 *vs* 0.49 %, P<0.01), the liver (3.90 *vs* 4.24 %, P<0.05), the kidneys (0.59 *vs* 0.79 %, P<0.01) and the empty stomach and guts (5.18 *vs* 5.51 %, P<0.01). These results confirm those obtained

Table 5 : Slaughtering data

	GENOTYPES			SEASONS		Error mean
	NZW	H	P	Summer	Winter	square*
Animals	20	20	20	30	30	
Live weight at slaughter (g)	2577^{Aa}	2776^{Bb}	2723^{Bb}	2543^{A}	2841^{B}	14295
Empty body weight (g)	2269^{Aa}	2436^{Bb}	2387^{Bb}	2246^{A}	2482^{B}	11724
% of empty body weight:						
Pelt	15.69	15.51	15.72	15.49	15.79	0.6203
Head and neck (1)	11.16^{b}	10.86^{a}	10.98^{ab}	10.93	11.07	0.2341
Distal fore legs	0.86	0.87	0.89	0.87	0.86	0.0035
Distal hind legs	2.13^{Aa}	2.45^{Bb}	2.49^{Bb}	2.38	2.33	0.0183
Heart	0.45	0.44	0.43	0.39^{A}	0.49^{B}	0.0027
Liver	4.29	3.96	3.96	3.90^{a}	4.24^{b}	0.3782
Kidneys	0.71	0.70	0.66	0.59^{A}	0.79^{B}	0.0045
Empty stomach and guts	5.24^{Aa}	5.42^{Bb}	5.38^{Bb}	5.18^{A}	5.51^{B}	0.0198
Warm carcass (2)	65.25	65.15	65.30	65.64^{b}	64.82^{a}	2.1016
Warm carcass (3)	55.59	56.05	55.97	56.45^{B}	55.29^{A}	2.0225

(1): with pelt. (2): with head and tail. (3): without head and tail ; *: 54 degrees of freedom ; A, B: P<0.01; a, b: P<0.05

in a previous research (CHIERICATO *et al.*, 1992). The lower percentage of stomach and guts is probably due to the lower summer feed intake .

The data related to the effect of the genotypes on the commercial joint preparations are shown in table 6. As regards the head and neck, examination of the results indicates higher levels (P<0.01) for the NZW (13.98 %) than the H (13.14 %) and P (13.55 %).
There were no significant differences on commercial joints data regarding the shoulders and fore legs, thoracic wall, loins and flanks which averaged, for the three genotypes studied, 12.08 %, 24.31 % and 16.50 %, respectively. These results confirm those of CHIERICATO and FILOTTO (1989).
The rump, nates and thighs cut proportion was higher (P<0.05) in the hybrids P (33.82 %) and H (33.76 %) with respect to the NZW (33.06 %). A similar result was obtained by research recently conducted by other authors (RISTIC, 1990).

As regards the fatty deposits, there is no difference between the three genetic types examined. The percentage of total fat is the same and on average equivalent to 6.03 %.

The data related to the effect of the season (table 6) show a basic similarity for all the values examined: the proportions of the head and neck, shoulders and fore legs and thoracic wall do not appear to be different and are on average to 13.56, 12.08 and 24.31 %, respectively.

Table 6 : Carcass jointing data.

	GENOTYPES			SEASONS		Error mean
	NZW	H	P	Summer	Winter	square*
Animals	20	20	20	30	30	
% warm carcass weight:						
Head and neck (1)	13.98^{Bb}	13.14^{Aa}	13.55^{ABa}	13.53	13.58	0.4488
Shoulders and fore legs	12.05	12.19	12.00	12.02	12.14	0.1755
Toracic cage	24.32	24.30	24.32	24.32	24.30	0.9937
Loins and flanks	16.59	16.61	16.31	16.35	16.65	1.2264
Rumps, nates and thighs	33.06^{a}	33.76^{b}	33.82^{b}	33.78	33.33	0.7889
Perirenal fat	2.02	2.25	2.11	1.62^{A}	2.63^{B}	0.1781
Perivisceral fat	2.78	3.15	3.06	2.46^{A}	3.54^{B}	0.5229
Interscapular fat	0.93	0.87	0.92	0.68^{A}	0.92^{B}	0.0299
Total fat	5.73	6.27	6.09	4.86^{A}	7.19^{B}	1.2839

(1) without pelt ; * 54 degrees of freedom ; A, B : P<0.01 ; a,b : P<0.05.

Also the intermediate part of the carcass, consisting of loins and flanks, is the same in both summer and winter averaging 16.50 %. The same applies to rump, nates and thighs where the values are on average equivalent to 33.56 %.

Finally, as regards the fatty deposits, higher values (P<0.01) were recorded in winter with regard to the perirenal fat (2.63 vs 1.62 %), perivisceral fat (3.54 vs 2.46 %) and scapular fat (0.92 vs 0.68 %). The higher adipogenesis of rabbits bred in the winter is related to the higher feed intake caused by low temperatures. Rabbits reared in the colder season eat more getting to a higher plane of nutrition. The greater amount of energy available enables the animals to satisfy thermoregulation requirements and to achieve a higher adipogenesis. The dissection data appear to be in accordance with the indications of a study previously carried out (CHIERICATO *et al.*, 1992), confirming that at the studied age, there is a substantial analogy among the cuts in the three examined genotypes.

CONCLUSIONS

The trials carried out in summer and winter, make an experimental contribution to an understanding of the effect of the genotype and season on intensive rabbit meat production.

The absence of significant interactions enabled to deal separately with the two experimental factors considered.

As regards the genotype, growth performances showed a similarity between purebreds and crossbreds.

The slaughtering data pointed out certain differences but some of them compensate the others : so at the end, slaughter yields were approximatively the same for purebreds and commercial crossbreds.

The division into commercial cuts showed a heavier head in the purebreds and heavier rump, nates and thighs for the hybrids.

Although these differences, it is not possible to give a final judgement with regard to the superiority of one genotype compared to the other.

As regards the season, it should be remembered that the effect of this variable is due mainly to the temperature which varied considerably from approximately 11°C in the winter to 27°C in the summer.

The seasonal effect was clear and significant and involved almost all the parameters considered. The effect of low temperatures determined an increase in intake of about 48 % and a considerably higher nutritive level, providing growth of over 20 % higher.

The greater amount of energy ingested, is partly employed for growth and partly to supply requirements of thermoregulation. These two factors together led to a reduction in feed efficiency of approximately 20 %.

At slaughter, the seasonal effect confirmed, in the both studies carried out, the tendency of the low temperatures to induce lower slaughter yields corresponding to thicker skin and larger gastrointestinal tract. The differences in yield of the warm carcass fluctuated around 1 %.

Dissection into the commercial cuts revealed the existence of a substantial similarity of values. A constant finding, on the other hand, was the greater deposit of perivisceral and scapular fat in animals bred in the winter.

The results obtained, in addition to provide a picture of the modifications that genotype and season can induce on the production of rabbit meat, suggest some topics for investigations in further researches. In particular it would be interesting to extend current knowledge to the effects of production cycles characterized by higher final live weights, higher energy level diets, and different temperature conditions.

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BIBLIOGRAPHY

A.O.A.C., 1970. Official Methods of Analysis. A.O.A.C. *William Byrd Press Inc., Richmond, Virginia.*

BELGIUM GOVERNMENT AGRICULTURAL RESEARCH CENTER, GHENT, 1984. Comparison of crossbred rabbits. *[An. Breed. Abstr., 52, 4913].*

BLASCO A., OUHAYOUN G., MASOERO G., 1992. Study of rabbit meat and carcass. Criteria and terminology. *Proc. of Vth World Rabbit Congress, Corvallis (USA)(July 1992), 2, 775-786.*

CHEEKE P.R., PATTON N.M., TEMPLETON C., 1982. Rabbit production. *The Interstate Printer and Publishers. Inc. Danville, Illinois.*

CHIERICATO G.M., RIZZI C., 1993. Ricerche sulle prestazioni riproduttive di differenti tipi genetici allevati in Italia. *In corso di pubblicazione.*

CHIERICATO G.M., BAILONI L., RIZZI C., 1992. The effect of environmental temperature on the performance of growing rabbits. *Proc. of Vth of World Rabbit Congress, Corvallis (USA), (July 1992), 2, 723-731.*

CHIERICATO G.M., FILOTTO U, 1989. A note on the fattening performance and carcass characteristics of New Zealand White, Hyla and Provisal rabbits. *J. Appl. Rabbit Res., 12, 156-158.*

HARVEY W.R., 1987. LSMLMW. PC2 Version. Mixed model least squares and maximum likelihood computer program. *Department of Dairy Science, Ohio State University, Columbia, Ohio.*

HULOT F., MATHERON G., 1980. Comparaison de la reproduction de lapins de deux genotypes; effets de l'age et de la saison. *Congreso Mundial de Cunicultura, Barcelona, 2, 293-302.*

I.N.R.A., 1989. L'alimentation des animeaux monogastriques: porc, lapin, volailles. *INRA, Paris.*

LEBAS F., OUHAYOUN J., 1987. Incidence du niveau proteique de l'aliment, du milieu d'elevage et de la saison sur la croissance et les qualités bouchères du lapin. *Ann. de Zoot., 36, 421-432.*

LEBAS F., COLIN M., 1992. World rabbit production and research situation in 1992. *Proc. Vth World Rabbit Congress, (July 1992), Corvallis (USA), I, 29-54.*

MARTILOTTI F., ANTONGIOVANNI M., RIZZI L., SANTI G., BITTANTE G., 1987. Metodi di analisi degli alimenti di impiego zootecnico. *Quaderni Metodologici n. 8, I.P.R.A., C.N.R., Roma.*

OKERMAN F., MAERTENS L., DE GROOTE G., 1987. Evaluation des performances de reproduction et d'engraissement de quelques souches hybrides de lapins. 2. Comparaison des resultats d'engraissement. *Revue de l'Agriculture, 40, 1553-1567.*

PARIGI BINI R., DALLE RIVE V., 1977. Metodi di stima del valore nutritivo dei mangimi concentrati per conigli in accrescimento. *Coniglicoltura, 14 (2-3), 33-40.*

RISTIC M., 1990. Effect of sex and final fattening weight on the carcass value of young rabbits. *[Anim. Breed. Abstr., 58, 1159*].

RISTIC M., ZIMMERMAN E., 1992. Slaughter value of young rabbits from fattening hybrides and pure breeding animals. *J. Appl. Rabbit Res., 15, 827-831.*

SAMOGGIA R., 1987. Esigenze fisioclimatiche dei conigli nell'allevamento intensivo. *Coniglicoltura, 24 (5), 20-24.*

SIMPLICIO J.B., CERVERA C., BLAS E., 1988. Effect of two different diets and temperature on the growth of meat rabbit. *Proc. IVth Worl Rabbit Congress, Budapest, October 1988, III, 74-78.*

STEPHAN E., 1981. Der Einfluss von Haltungstemperaturen auf die Mastleistung von Fleischkanichen verschiedener Rassen (vorlaufige Mitteilung). *KleintierPraxis, 26, 313-317.*

UNA, 1992. Produzione avicola in Italia. *Anno 1991, 1, 2-27.*