COMPARISON BETWEEN PROVISAL AND HYLA RABBIT STRAINS
I - SLAUGHTERING PERFORMANCES AND MUSCLE COMPOSITION

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Abstract - The data were collected on sixty fattening Provisal rabbits (PROV) and sixty fattening HYLA rabbits of both sexes, slaughtered at 74, 84 and 94 days in two replicates, in order to investigate the presence and the magnitude of genetic and ontogenetic (age-sex) effects.
Genetic differences rarely interacted with age ; regarding higher fatness (1.04 *vs* 0.96 perirenal fat % ; 2.31 *vs* 1.99 % intramuscular Longissimus dorsi fat) and low gastrointestinal tract (18.14 *vs* 18.96 %) the PROV rabbits appeared to be a slightly more precocious than HYLA, but as regard to a higher development of hindleg part (13.25 *vs* 13.45 %) with an improved meat/bone ratio (5.99 *vs* 6.12 ; P=0.17) and to a lower collagen contents in the Longissimus dorsi muscle (1.17 *vs* 1.13 %) the reverse appeared true. The age dependencies were strong for most of traits and well accorded to theory; at the ending point of 94 days, no limit was reached either for the growth of perirenal fat or for the meat/bone ratio of hindleg. Some sex differences were linked to: the hindleg proportion (14% for the males and 13.06 for the females); the full gastrointestinal tract (18.95 *vs* 18.15 %); the skin incidence (13.43 *vs* 13.76%) and also to meat composition: more fat in the males (7.94 *vs* 6.57 and 2.28 *vs* 2.02 of intramuscular fat % in HL and in LD) and, conversely, less protein contents.
It was confirmed a limited amount strain potential for slaughtering performances and meat composition.

INTRODUCTION

In Italy, rabbit production includes a significant variety of selected endogenous and exotic strains. It could be interesting for producers and transformers to evaluate differences in genetic origins at different weight-age (ontogenetic) stages. The strong opposition between growth power and slaughtering performances, mainly dressing-out percentage, may be a challenge to ascertain the best combinations for higher weights. This was previously investigated at ISZ Laboratory (MASOERO, 1987a ; AUXILIA, 1988) and recently by other Italian researchers (BERNARDINI BATTAGLINI *et al.*, 1995).
At Bologna University, previous investigations of LAMBERTINI *et al.* (1992, 1994) reported the neighbouring of HYLA rabbits and Provisal ones, a strain whose old origins raised from the first European commercial hybrids (MASOERO, 1987b).
The aim of this trial (first part) was to evaluate the actual situation in a comparative purpose both between different genetic lines nowadays very popular in Italy and between different time-points (ontogenetic and phylogenetic stages).

MATERIAL AND METHODS

The experiment started in a commercial herd where the two lines were raised together during the spring season ; the litters born by natural matings were standardized at 7-8 pups, then weaned at 35 d and the rabbits were twinned in wired superposed cages .
All the rabbits were fed *ad libitum* with a commercial pelleted feed (17. I% crude protein, 14.5% crude fibre, 2430 Kcal DE/kg, calculated according to PARIGI-BINI and DALLE RIVE, 1977) till to three fixed ages averaging 74, 84 and 94 days. The data were collected on sixty fattening Provisal rabbits and sixty fattening Hyla rabbits of both sexes, in two replicates.
The slaughter performances and related variables of the not fasted rabbits were in accordance with the harmonized methodology of BLASCO *et al.* (1993) with hindleg cut-out and dissection of the uncooked part but modified with further separation of the single three bones (femur, tibia and coxa) from fat plus tendons (included in meat) and from muscles.

From half of the rabbits samples of the Longissimus dorsi pars lumbalis (LD), removed from perimisium, and of the hindleg muscles (HL) were freeze stored, then freeze-dried for chemical analysis: lipids, without hydrolysis (BLIGH and DYER, 1959), protein (MARTILLOTTI *et al.*, 1987), collagen of LD estimated as 7.25 times the hydroxiproline contents (Technicon Auto Analyzer II - Industrial Method n. 513-77T - 15 November 1977 - Hydroxiproline in bone tissue acid hydrolysate). The chemical compositions of muscles of the other sixty rabbits were predicted by powerful equations using the Near Infrared Reflectance Spectroscopy (NIRS) as detailed in the companion paper (second part, MASOERO *et al.*, 1996).
Statistical analysis was performed by SAS (1987) software according to a three factorial fixed linear model:

$$Yijkl = m + Gi + Aj + Sk + G*Aij + Eijkl$$ where:

Y is each of the 23 dependent variables;
m is the unknown common value;
G is the Genetic group effect (I=Provisal, 2=HYLA);
A is the Age effect (1=74 d, 2=84 d, 3=94 d);
S is the Sex effect (I=male, 2=female);
G*A is the first order interaction;
E is the random normal deviation of individuals ijkl.

RESULTS AND DISCUSSION

The genetic effects rarely interacted with age, thus the n. 1 and 2 Tables report the statistical analysis of the main factors in the experiment for each of the 23 considered traits. As regard to the three interacting traits the Table 3 enhances age effects by genetic groups which were very limited when compared to other genetic experiments (BATTAGLINI *et al.*, 1995).
According to the univariate analysis, the PROVISAL rabbits, compared to HYLA, showed significant reductions in full gastrointestinal tract (a new result *vs* previous results of LAMBERTINI *et al.*, 1994), in hindleg incidence, in protein contents of LD muscles, while significant prevalences were observed in kidneys, in hindleg bones (mainly femur), in contents of LD intramuscular fat and in LD collagen (near to significativity). Therefore the maturity rate of the PROVISAL could be considered slightly more pronounced because of its higher fatness and lower gastrointestinal tract. On the contrary the hindleg incidence and the higher collagen contents supported a more juvenile state.
The age effects were strong and interested almost all the considered variables. No ontogenetic evolution was displayed only for three variables: scapular fat (a poor indicator of fatness); hindleg incidence (according to BERNARDINI BATTAGLINI *et al.*, 1995) ; and LD intramuscular fat, but this last finding was surprising because of the general agreement about this muscular site as ontogenetic indicator (PARIGI-BINI *et al.*, 1992). Otherwise the hindleg muscles were much more representative of the ontogenetic process.

It was confirmed the general tendency to increase fatness and meat/bone ratio and dressing-out components by slaughter age; but the critical age was focused between 74 and 84 days, when a lot of traits stopped their increasing allometry (dressing out percentage, skin in the Provisal, but not perfectly in the HYLA, see Table 3, gut, hindleg's bones, intramuscular fat of HL) as well as their decreasing allometry (liver, kidneys). At the ending point of observations apparently no limit was reached either for the growth of perirenal fat or for the meat/bone ratio of HL.
The collagen contents of LD was decreasing by age in the two genetic types, but the pattern was different (table 3) because in the HYLA the minimum level was reached earlier at 84d, while in PROVISAL at that age the level was intermediate, and this was the reason of the nearly significant lower value of collagen in LD muscles of HYLA.
An abnormal decreasing evolution of drip loss was displayed (Table 1) probably because of perturbances in the experimental conditions of the slaughtering replicates.

As regards the sex factor, the males produced carcasses with significantly higher percentage of HL than the females. Although the male subjects had less skin, the dressing-out resulted lower, because of higher weight of gastrointestinal tract.
Also meat quality was affected by sex : in fact the hindleg muscles of males were richer in fat and poorer in protein than those of females as well as the LD muscles, even if this was less evident; this fact could be linked to the observed higher drip loss in the females, a finding probably due to the specificity of the compared strains.

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Table 1: Statistical analysis of the main factors in the experiment

			Genetic type			Age			Sex	
			PROV	HYLA		d74	d84	d 94	M	F
R^2	sd	P<	LSM	LSM	P<	LSM	LSM	LSM	LSM	LSM
1 -Live Slaughter Weight (LSW)						C	B	A		
g 0.58	188	0.925	2498	2501	0.000	2221	2541	2736	0.544	2489	2510
2 -Dressing Out (DOP)						B	A	A		
% 0.30	1.68	0.182	59.14	58.73	0.000	57.4	59.85	59.46	0.326	58.78	59.09
3 -Drip Loss (DLP)						A	C	B		
% 0.79	0.46	0.455	3.54	3.61	0.000	4.33	2.39	4.01	0.000	3.34	3.81
4 -Skin (SKP)						B	A	A		
% 0.47	0.82	0.172	13.70	13.49	0.000	12.5	14.27	13.95	0.033	13.43	13.76
5 -Full Gastrointestinal Tract (FGTP)						A	B	B		
% 0.23	1.80	0.016	18.14	18.96	0.000	19.4	17.75	18.45	0.017	18.95	18.15
6 -Chilled Carcass Weight (CCW)						C	B	A		
g 0.61	123	0.536	1483	1469	0.000	1276	1519	1633	0.239	1463	1489
7 -Liver (LvP)						A	B	B		
% 0.15	0.69	0.143	5.34	5.15	0.000	5.58	5.19	4.97	0.578	5.21	5.28
8 -Kidneys (KiP)						A	B	B		
% 0.20	0.14	0.002	1.04	0.96	0.000	1.08	0.98	0.94	0.881	1.00	1.00
9 -Perirenal Fat (PFaP)						B	ABb	Aa		
% 0.20	0.47	0.282	1.38	1.29	0.000	1.08	1.31	1.62	0.286	1.38	1.29
10 -Scapular Fat (SFaP)										
% 0.03	0.18	0.148	0.32	0.27	0.795	0.28	0.29	0.31	0.499	0.28	0.30
11 -Hind Leg (HLP)										
% 0.34	0.52	0.037	13.25	13.45	0.215	13.3	13.45	13.24	0.000	14	13.06
12 -Hind Leg Weight (HLW)						C	B	A		
g 0.57	17	0.813	195	195	0.000	168	202	214	0.122	197	192
13 -Femur (FmW)						B	A	A		
g 0.46	1.03	0.072	11.99	11.64	0.000	11.2	11.96	12.27	0.366	11.90	11.73
14 -Tibia (TiW)						B	A	A		
g 0.22	0.84	0.825	8.00	8.03	0.000	7.48	8.15	8.42	0.675	7.98	8.05
15 -Coxa (CxW)						B	A	A		
g 0.24	1.16	0.756	7.90	7.83	0.000	7.05	8.36	8.18	0.623	7.92	7.81
16 -Fat and tendons (FTW)						B	B	A		
g 0.26	2.13	0.275	5.26	4.83	0.000	4.05	4.89	6.19	0.140	5.34	4.75
17 -Meat bone ratio of hindleg (MBRHL)						C	B	A		
0.52	0.51	0.174	5.99	6.12	0.000	5.57	6.14	6.46	0.166	6.12	5.99
18 -Meat fat ratio of the hindleg (MFRHL)						a	ab	b		
0.11	27.5	0.680	42.02	44.12	0.04	49.91	44.91	34.3	0.682	44.11	42.03

A>B>C : P<0.01 a>b>c: P<0.05

Table 2: Statistical analysis of the main factors in the experiment

			Genetic type			Age				Sex	
			PROV	HYLA		d 74	d 84	d 94		M	F
R^2	sd	P<	LSM	LSM	P<	LSM	LSM	LSM	P<	LSM	LSM
19 -Intramuscular fat - hindleg (IFaHLP)						B	A	A			
% 0.24	2.24	0.904	7.28	7.23	0.000	6.15	7.54	8.07	0.001	7.94	6.57
20 -Protein - hindleg (PrHLP)						A	AB	B			
% 0.26	1.96	0.881	83.86	83.92	0.009	84.61	83.84	83.22	0.000	83.2	84.55
21 -Intramuscular fat - longissimus dorsi											
% 0.21	0.75	0.023	2.31	1.99	0.439	2.11	2.28	2.07	0.063	2.28	2.02
22 -Protein - longissimus dorsi (PrLDP)						AB	B	A			
% 0.16	0.85	0.072	88.31	88.60	0.015	88.41	88.19	88.76	0.045	88.2	88.61
23 -Collagen - longissimus dorsi (CollLDP)						A	B	C			
% 0.40	0.13	0.063	1.17	1.13	0.000	1.27	1.15	1.03	0.082	1.13	1.17

A>B>C : P<0.01 a>b>c: P<0.05

Table 3: Statistical analysis of the interactive factors

			Genetic type * Age					
			PROVISAL			HYLA		
	R^2	sd	d 74 LSM	d 84 LSM	d 94 LSM	d 74 LSM	d 84 LSM	d 94 LSM
Skin (SkP)			b	a	a	c	a	b
%	0.47	0.8239	12.33	14.31	14.46	12.81	14.20	13.44
Kidneys (KiP)			a	b	c	a	a	a
%	0.20	0.1459	1.15	1.04	0.94	1.00	0.92	0.94
Collagen - longissimus dorsi (CollLDP)								
% (DM)			a	b	c	a	b	b
	0.40	0.1336	1.30	1.21	1.00	1.23	1.08	1.06

a<>b<>c within type

CONCLUSION

The two tested samples from selected strains showed very similar slaughtering performances with few interactions with age .

Nevertheless the full gastrointestinal tract of the HYLA strain was more weight than Provisal one of about 0.8 % ; furthermore the dissected carcass point out some prevalence of hind part in the HYLA.

The meat composition was quite influenced by strain being LD muscles of Provisal rabbits richer in fat and collagen than Hyla ones; but much more by age, which increased mainly the fat content of hindleg muscles and diminished collagen level of LD when the slaughter age augmented. Finally also the ontogenetic sex factor modified the chemical composition of meat, particularly in hindleg muscles which were fatter of 20% in males than in females.

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Confronto fra conigli provisal e hyla: i. caratteristiche di macellazione e composizione muscolare - I dati furono raccolti su sessanta conigli in accrescimento Provisal (PROV) e sessanta HYLA, ambosessi, macellati a 74, 84 o 94 d, in due repliche, per studiare la presenza e la consistenza di effetti genetici e ontogenetici (età-sesso). Le differenze d'ordine genetico raramente interagirono con l'età. A causa del maggiore ingrassamento (1.04 vs 0.96 % di grasso perirenale e 2.31 vs 1.99 % di grasso intramuscolare del Longissimus dorsi) e della riduzione di visceri (18.14 vs 18.96 %) i conigli PROV risulterebbero più precoci rispetto agli HYLA; tuttavia parrebbe it contrario se si considerano la prevalenza di coscia (13.25 vs 13.45 %), con una tendenza a un migliore rapporto carne/osso (5.99 vs 6.12 ; P=0.17), e il minore tenore di collageno (1.17 vs 1.13 %). Le dipendenze dall'età furono forti per quasi tutti i caratteri e ben in accordo con la teoria: alla valutazione finale di 94 d, nessun limite fu raggiunto né per il rapporto carne/osso né per it grasso perirenale. Alcune differenze risultarono per il sesso : nei maschi apparve una maggiore incidenza della coscia (14 vs 13.06%) dei visceri (18.95 vs 18.15 %) e del grasso (7.94 vs 6.57 e 2.28 vs 2.02 % di grasso intramuscolo in HL e in LD). La pelle risulto invece più leggera (13.43 vs 13.76%). Si confermo una sostanziale affinità fra i ceppi a confronto.