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SUMMARY - Carcass quality of Gigante de España bred rabbits, both pure and commercial cross (Solam males x Gigante de España females) are studied. The killing-out percentages do not differ significantly between the two groups, showing a commercial dressing of 57.50% (purebred) and 56.82% (crossbred) and a biological dressing of 69.15% and 68.36% respectively. Carcasses from this crossing are shorter and wider than those obtained from purebred. However, the tissular composition is similar in both experimental groups: 78.20% and 78.35% muscle, 16.73% and 16.36% bone and a muscle:bone ratio of 4.69 in purebred and 4.81 in crossbred rabbits. The carcass level of fatness does not differ amongst either type, but the percentage of fat in Gigante de España females is low and below that of the males of the same breed (4.41% vs. 5.82%). The carcass conformation is also influenced by sex, that of males being more compact. Type and sex scarcely modify the carcass percentage of joints.

Key words: Gigante de España breed, crossing, carcass quality.

RESUME - "Qualité de la carcasse de la race Gigante de España en lignée pure et en croisement industriel". Nous étudions la qualité de la carcasse des lapins de la race Gigante de España en lignée pure et en croisement industriel (mâles Solam x femelles Gigante de España). Les rendements de la carcasse ne diffèrent pas significativement entre les différents groupes. Quant au rendement commercial, il est de 57,50% en race pure et de 56,82% chez les croisés, alors que leur rendement véritable est de l'ordre de 69,15% et 68,36% respectivement. Les carcasses provenant du croisement sont plus courtes et plus larges que celles obtenues en race pure. Malgré cela, la composition tissulaire est semblable dans les deux groupes expérimentaux: 78,20% et 78,35% de muscle, 16,73% et 16,36% d'os et un rapport muscle/os de 4,69 en lignée pure et de 4,81 chez les croisés. Il n'y a pas de différence concernant l'état d'engraissement entre les divers types. Cependant les femelles Gigante de España présentent un faible pourcentage de graisse, inférieur à celui des mâles de leur propre race (4,41% vs. 5,82%). Le facteur sexe influe aussi sur les dimensions des carcasses, en effet celles qui proviennent des mâles sont plus compactes que celles des femelles. Type et sexe modifient à peine la proportion de pièces de découpe des carcasses.

***Mots-Clés** : Race Gigante de España, croisement, qualité carcasse.*

Introduction

Rabbit carcasses show a considerable proportion of muscle and little fatness with respect to other species. Therefore, OUHAYOUN (1984) estimates that a New Zealand purebred standard rabbit carcass without head and viscera, contains 79.1% **muscle**, 16.5% **bone** and 4.4% **fat** (2.250 kg slaughter weight and 11 weeks old).

The **regional composition** in rabbit carcasses has little commercial interest because cutting practices are nowadays a minority. The jointed carcass has been used, however, to learn the anatomical regions pattern of development, carcass tissue distribution, and so to establish prediction equations of the carcass tissular composition.

Rabbit carcass **conformation** is regarded as a minor quality trait by retailers of this species, although, when buying a carcass, the purchaser seems to prefer it short and compact. Carcass measurements, however, are not good tissular composition predictors in rabbits (BLASCO *et al.*, 1984).

The Gigante de España breed has medium performances in commercial slaughter weights (1800-2200 g). Nevertheless, its carcasse longitudinal dimensions show certain predominance when compared to those of hybrid rabbits. The purebred Gigante de España characteristics will be shown below, studying the tissular and regional composition and also the shape and its killing-out percentages. The quality modifications of the

introduction of the Solam males as a paternal line are also evaluated.

Materials and methods

OBTAINING CARCASS AND OFFAL

A group of 14 Gigante de España females were bred purely using males of the same breed, another 13 females, also Gigante de España, were mated successively to Solam males. These matings took place during the September-July period.

A sample of 11 entire litters of Gigante de España breed (69 rabbits) and 12 litters resulting from crossing Solam males and Gigante de España females (70 rabbits) were slaughtered when the young rabbits weighed nearly 2 kg.

Both litter types were randomly selected among those obtained from the experimental period.

The slaughter was carried out in a specialised abattoir, 15 km away from the farm, and the animals had not kept a previous fasting period.

The individual weight of the rabbits was controlled at the departure from the farm and so was the carcass, weighed after the slaughter (15-30 minutes post-mortem) (hot carcass weight).

The commercial carcass contains head, kidneys, liver, thoracic viscera and limbs, which are sectioned off at the metatarsal and metacarpal bones.

The components which are not part of the carcass were weighed: skin, ears, feet, spleen, mesenteric fat, urinary tract and alimentary tract. The weight of both the urinary bladder and alimentary tract was determined including its contents and also after being emptied, cleaned and drained. The digestive and vesical contents were calculated by difference and so was the empty live weight.

CONFORMATION MEASUREMENTS

Before all the rabbits were slaughtered, 60 rabbits were randomly selected among them and assigned to study carcass quality (14 males and 16 females from each group).

The carcasses were stored at 4ºC for 24 hours after slaughter and then their weights were recorded (cold carcass weight).

The pelvic length and girth were determined as described by DELAVEAU (1978), as well as the carcass length (from the sacro-coccygeal articulation to atlanto-occipital articulation) and several other length, width and depth measurements (LOPEZ and SIERRA, 1986).

These measurements were taken on the refrigerated carcass hanging upside down, without separation between the rear limbs.

REGIONAL AND TISSULAR COMPOSITION

Thymus, trachea+lungs+heart, liver, kidneys, diaphragm and both subcutaneous and pelvic+renal adipose depots were removed from the refrigerated carcass and weighed.

Thereafter the carcass joints were obtained following the cutting model and anatomic referential points described by DELTORO and LOPEZ* (1985): head, neck+breast+ribs, loin, forelegs, hind legs and abdominal wall. For this study, however, neck and breast+ribs were differentiated by a cross-section made between the last cervical vertebra and the first thoracic one.

Muscle, bone, intermuscular fat and remainders were removed in every joint, except the head, using the complete dissection method. Remainders, including main blood vessels, lymphatic vessels, nerves, ganglions and gland residues, were regarded as an edible fraction and added to muscle weight in the tables (1).

Calculations relating to tissular composition were made by using the corrected carcass weight. This is obtained by adding the muscle, bone and intermuscular fat weight from each joint to the subcutaneous and pelvic+renal fat weight. The corrected carcass weights have been used in some studies referring to tissular composition in cattle and sheep (BERG *et al.*, 1978, WOOD *et al.*, 1980, amongst other authors).

STATISTICAL STUDY

Carcass characteristics were analysed according to the following model:

$$Y_{ijk} = u + T_i + S_j + (TS)_{ij} + e_{ijk}$$

where u= general means

T_i= effect of type, i=1,2

S_j= effect of sex, j=1,2

$(TS)_{ij}$= interaction effect between type and sex

e_{ijk}= residual term

(1) The average weight of remainders was 7.44 g in the whole set of carcasses.

Table 1. Means (x), standard deviation (SD) and significance test for the effects of type and sex on liveweight, carcass and offal weight and dressing percentages

	GIGANTE DE ESPAÑA		SOLAM x G. E.		F-significance		
	x ±	SD	x ±	SD	G	S	GxS
Live weight in farm (g)	2012.36	98.53	2049.58	118.47	*	NS	NS
Empty body weight (g)	1736.98	90.87	1753.15	110.29	NS	NS	NS
Hot carcass weight (g)	1200.84	68.72	1197.88	80.16	NS	NS	NS
Cold carcass weight (g) (1)	1149.20	73.13	1164.50	78.88	NS	NS	NS
Comercial dressing (%) (1)	57.50	1.66	56.82	2.44	NS	NS	NS
Biological dressing (%)	69.15	2.25	68.36	2.76	NS	NS	NS
Offal weight (g)	440.71	30.51	455.81	40.36	*	NS	NS
Skin + ears + feet (g)	290.39	21.79	303.28	27.82	**	NS	NS
Empty alimentary tract + bladder (g)	126.41	15.47	127.93	16.58	NS	NS	NS
Spleen (g)	1.11	0.30	1.09	0.24	NS	NS	NS
Mesenteric fat (g) Males + females	22.81	5.30	23.51	4.28	NS	*	*
Males	24.28a	5.12	23.52a	4.72			
Females	20.84b	4.96	23.51a	3.73			
Mesenteric fat (%EBW) Males + females	1.31	0.27	1.34	0.21	NS	*	*
Males	1.39a	0.26	1.33a	0.23			
Females	1.20b	0.26	1.35a	0.19			

(1) n= 30 Gigante de España and 30 SOLAM x Gigante de España.
NS= not significant, *= P<0,05, **= P<0,01.
Means bearing different letters differ significantly (P<0,05).

When the type-sex interaction had a significant effect, the means of each subgroup were compared by the DUNCAN test (STEEL and TORRIE, 1980).

Results and discussion

COMMERCIAL CARCASS:

DRESSING PERCENTAGE AND CONFORMATION

When the young rabbits were slaughtered, their average weights when leaving the farm were 2012.36 g in Gigante de España and 2049.58 g in Solam x Gigante de España.

The slaughter live weight is normally used in the Spanish market and allows getting refrigerated carcasses of 1.149 kg and 1.164 kg from the rabbits being studied (Table 1). This carcass weight is the most widely demanded in Spain, a country where light carcasses are preferred and requested.

The ratio between cold carcass weight and live weight before leaving the farm has been considered an estimation of commercial dressing percentage, because the distance between the farm and the abattoir is short and the rabbits were slaugtered just after arrival, with scant losses on transport and waiting period until slaughter under these conditions (LOPEZ and SIERRA, 1986). Their value was 57.50% in purebred rabbits and 56.82% in crossbred.

The biological dressing percentage indicates the hot carcass weight with respect to the empty body weight, reaching 69.15% and 68.36% in the experimental groups.

The **crossbreeding** did not improve the killing-out percentage. Even slightly lower values were detected in mean of Solam x Gigante de España group, as a consequence of the higher offal weight and, especially, in the skin+ears+ feet component.

On the contrary, Solam males brought about a relevant conformation modification, providing carcasses with shorter pelvic and dorsal lengths and wider in all the trunk regions (Table 2). The cold carcass weight: carcass length ratio tended to be higher in this group, although the differences are not significant.

Table 2. Means and test of significance for the effects of type and sex on measurements of carcass conformation.

	GIGANTE DE ESPAÑA		SOLAM x G. E.		F-significance		
	Males	Females	Males	Females	G	S	G x S
Carcass length	31.39	31.75	31.09	31.68	NS	NS	NS
Leg length	20.79	21.32	20.91	20.74	NS	NS	*
Pelvic length	8.16	8.54	7.98	8.15	**	*	NS
Dorsal length	16.44	16.92	16.09	16.41	*	*	NS
Leg width	8.53	8.63	8.50	8.45	NS	NS	NS
Pelvic width	5.01	4.90	5.08	5.14	*	NS	NS
Loin width	6.30	6.14	6.48	6.52	*	NS	NS
Shoulder width	5.95	5.85	6.17	5.98	*	NS	NS
Highest thoracic width	8,53	8.81	8.87	9.14	**	*	NS
Pelvic girth	15.24	14.74	15.40	14.81	NS	**	NS
Thoracic depth	7.55	7.49	7.62	7.39	NS	NS	NS
Cold carcass weight/carcass length	37.20	35.81	38.12	36.22	NS	*	NS

NS= not significant, *= P<0,05, **= P<0,01

Related to the **sex factor**, it seems to exert a slight influence on slaughter traits which is stronger in the carcass shape.

In effect, only the mesenteric fat differed between sexes: the weight of this fat depot being heavier in males than in females, especially in purebred. When mesenteric fat weight is indicated as a percentage of the empty body weight, the statistical differences remain, and it shows that Gigante de España females mesenteric adipose depot is less developed than in the males of the same breed and also less than Solam x Gigante de España males and females.

Referring to conformation, male carcasses presented shorter length of trunk (pelvic and dorsal), narrower thorax and bigger pelvic girth than females. The carcass was also more compact in males.

Therefore, under experimental conditions, the shape of male carcasses may be more attractive to the purchaser, and the commercial cross allows this quality trait improvement. Nevertheless, conformation differences between sexes or types do not involve relevant changes in tissular or regional composition of carcasses, as it is put forward in the following chapter.

REGIONAL COMPOSITION OF COMMERCIAL CARCASS

The joint partition was similar in both studied types, only the breast+ribs varied (Table 3).

This difference seems to be determined by a decrease in the percentage of breast+ribs in crossbred female carcasses compared with pure breed ones (P<0.05). Such a result can be explained as a response to modification in the maturity degree of females due to crossbreeding. So breast+ribs show a first stage negative allometric development during which its percentage of carcass weight decreases and, consequently, more mature carcasses have a lower proportion of this joint (DELTORO and LOPEZ, 1986).

On the other hand, the scarce differences between types and sex in the percentages of anatomic regions seem to prove the **anatomic harmony** stated in sheep by BOCCARD and DUMONT (1960), according to which carcasses with similar weight and similar level of fatness show a constant proportion of joints, independent from their conformation.

TISSULAR COMPOSITION OF THE CARCASS

The tissular carcass composition, expressed in either absolute values or related to the corrected carcass weight, was almost alike in purebred and crossbred young rabbits (Table 4).

In this way, muscle was 78.20% in the first group and 78.35% in the second, bone was 16.73% and 16.36% respectively. The muscle: bone ratio value was 4.69 in Gigante de España and 4.81 in Solam x Gigante de España.

The total fat (intermuscular+subcutaneous+pelvic+renal), which did not vary in type effect, differed between sexes: male carcasses showed higher quantity of fat.

When fat is expressed as a percentage of the corrected carcass weight, differences between males and females remain and are in agreement with those

Table 3. Means (x), standard deviation (SD) and significance test for the effects of type and sex on joint and viscera percentages in commercial carcass.

	GIGANTE DE ESPAÑA		SOLAM x G. E.		F-significance		
	x ± SD		x ± SD		G	S	GxS
Head	9.38	0.41	9.79	1.17	NS	NS	NS
Neck	4.61	0.81	4.66	0.76	NS	NS	NS
Breast + ribs Males + females	15.35	1.44	14.71	0.85	*	NS	*
Males	15.13ab	1.46	15.17ab	0.64			
Females	15.55a	1.45	14.31b	0.81			
Loin	15.04	1.08	15.20	1.16	NS	NS	NS
Abdominal wall	4.21	0.38	4.24	0.51	NS	NS	NS
Fore-legs	9.30	0.55	9.40	0.53	NS	NS	NS
Hind-legs	28.60	1.18	28.91	1.08	NS	NS	NS
Thymus	0.56	0.13	0.55	0.11	NS	NS	NS
Trachea + lungs + heart Males + females	1.64	0.17	1.51	0.15	**	*	NS
Males	1.70	0.20	1.55	0.16			
Females	1.58	0.12	1.48	0.14			
Diaphragm	0.44	0.05	0.43	0.04	NS	NS	NS
Liver	6.99	1.01	7.05	1.15	NS	NS	NS
Kidneys	1.10	0.10	1.16	0.14	NS	NS	NS
Subcutaneous fat	0.89	0.39	0.93	0.33	NS	NS	NS
Pelvic + renal fat Males + females	1.27	0.38	1.20	0.32	NS	**	NS
Males	1.42	0.44	1.29	0.22			
Females	1.14	0.28	1.11	0.39			

NS= not significant, *= P<0,05, **= P<0,01.
Means bearing different letters differ significantly (P<0,05).

Table 4. Means (x), standard deviation (SD) and significance test for the effects of type and sex on tissular composition of the corrected carcass.

	GIGANTE DE ESPAÑA		SOLAM x G. E.		F-significance		
	x ± SD		x ± SD		G	S	GxS
Corrected carcass weight (g) M + F	867.47	66.13	880.11	69.54	NS	*	NS
Males	880.40	84.36	904.16	57.28			
Females	856.16	44.66	859.06	74.12			
Muscle (g)	678.38	52.58	689.63	57.31	NS	NS	NS
Bone (g)	144.74	8.60	143.66	11.52	NS	NS	NS
Total fat (g) Males + females	44.35	13.48	46.83	11.63	NS	**	NS
Males	51.73	14.86	48.96	8.00			
Females	37.90	8.03	44.96	14.07			
Muscle: bone ratio	4.69	0.33	4.81	0.38	NS	NS	NS
Muscle (%)	78.20	1.16	78.35	1.47	NS	NS	NS
Bone (%)	16.73	1.04	16.36	1.08	NS	NS	NS
Total fat (%) Males + females	5.07	1.24	5.30	1.14	NS	**	*
Males	5.82a	1.21	5.40a	0.72			
Females	4.41b	0.86	5.21a	1.42			

NS= not significant, *= P<0,05, **= P<0,01.
Means bearing different letters differ significantly (P<0,05).

observed in the pelvic+renal fat in the commercial carcass (Table 3) as well as with those pointed out in the mesenteric adipose depot (Table 1). The percentage of subcutaneous fat also tends to be higher in males, although the grade of signification is lower (P=0.057) (Table 3).

A type-sex interaction effect is moreover observed in the mesenteric depot and in the percentage of total fat. Such interaction indicates that the differences in adipose contents from one sex to another do not become apparent in the same manner in both types. Thereby, purebred females showed a level of fatness which was particularly low in relation to purebred males, and crossbreeding decreased the differences between sexes.

The results obtained in tissular composition do not appear to be related to either slaughter age or growth rate, which are similar in both sexes within each type.

Also, it is amazing that male carcasses show higher fatness, when it is known that sex acts on tissular composition by favouring the development of adipose tissue in females, and always at ages above that of slaughter in this species (LOPEZ and DELTORO, 1984).

Nevertheless, it has also been proved that adult format determines body composition, so that small size rabbits, with the same live weight or age, are closer to maturity and their carcasses show a higher level of fat (OUHAYOUN, 1983) than those of a big adult size.

Consequently, the differences in fatness in Gigante de España males and females may be put down to the different degree of maturity at a constant slaughter weight. Males are more mature due to their lower adult size.

The composition of mature purebred carcasses, which is nowadays being studied, will let us know the degree of development of carcasses and of tissues in males and females with commercial slaughter weights.

Conclusions

1. Under our experimental conditions, the commercial cross hardly improves carcass quality of Gigante de España breed, conformation traits being the ones more highly modified.

2. Sex determines a level of fatness which is higher in male carcasses than in those from females, especially in pure breed.

3. Carcasses from rabbits with different conformation may have similar tissular and regional composition.

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