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Effects of diets during growth and their repercussion on the quantitative and qualitative characteristics of carcass

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SUMMARY - In this experiment the following productive parameters were assessed: average daily gain (ADG), feed conversion efficiency index (CI) and the evolution of the back fat in pure-breed Alentejano genotype (AL) and cross-breed (LW x Duroc) x AL pigs, using two different diets: balanced commercial feed (A) *vs* Triticale (T) with premix and lysine supplements. A total of 48 sexually neutralized male and female pigs were used, with an initial average weight of 31.3 kg, which were split into four groups of 12: (i) Alentejano, fed with Triticale; (ii) Alentejano fed with commercial feed; (iii) Cross-breed, fed with Triticale; and (iv) Cross-breed, fed with commercial feed. The animals were housed in individual cells, with automatic feeding and drinking equipment, making it possible to have a controlled individual feeding system, in which the daily amount of feed supplied was adjusted every fortnight according to need (INRA tables, 1987) up to a maximum of 3.1 kg/animal per day, distributed as a single daily meal. During the experiment the animals were weighed every fortnight in order to determine the ADG. The amount of feed intake was assessed with the same frequency in order to determine the CI. The back fat thickness as well as the depth of the *longíssimus dorsi* muscle were measured monthly, using echography. The animals were slaughtered when they reached ±100 kg live weight and ten months in age. Once slaughtered, the carcasses were dissected in order to assess the percentage of lean meat, the fat/muscle relation and the muscle/bone relation. When comparing the genotypes, a significantly higher (P<0.01) ADG was observed in the cross-bred animals, although the differences in CI were not significant. Considering the effect of diets, in treatment A the ADG was higher (P<0.001) as well as CI (P<0.001). The genotype x diet interaction was significant in both parameters (P<0.01). When assessing the carcasses it was observed that the cross-bred pigs had a greater proportion of muscle and noble pieces than the pure-bred Alentejano (P<0.001) and thus a smaller proportion of fat (P<0.001). The diet significantly (P<0.05) affected the percentage of fat, the loin area and the bone weight. In the genotype x diet interaction, the differences were not significant.

Key words: Alentejano breed, farm diets, carcass characteristics.

RESUME - *"Etude de l'influence du régime alimentaire pendant la croissance sur les caractéristiques quantitatives et qualitatives de la carcasse". Dans cet essai, nous avons évalué l'influence de 2 régimes (aliment commercial équilibré (A)* vs *Triticale (T) complémenté avec prémix et lysine) sur les paramètres productifs suivants : gain moyen quotidien (GMQ), indice de conversion (IC) et évolution de l'épaisseur de la graisse dorsale, chez les génotypes race pure Alentejana (AL) et croisés (LW x Duroc) x AL. 48 animaux, mâles et femelles sexuellement neutralisés et de poids vif initial de 31,3 kg ont été utilisés. Ils ont été répartis en 4 groupes de 12 animaux : (i) Alentejanos, nourris avec du Triticale ; (ii) Alentejanos, nourris avec une ration commercial ; (iii) Croisés, nourris avec du Triticale ; et (iv) Croisés, nourris avec une ration commerciale. Les animaux ont été placés dans des cages individuelles, équipées d'une auge et d'un abreuvoir automatique, qui permettent ainsi de contrôler l'alimentation individuelle. Les rations journalières ont été ajustées tous les quinze jours sur la base du poids vif (tables, INRA, 1987) jusqu'à un maximum de 3,1 kg/animal par jour, distribués en un repas unique par jour. Pendant l'essai des pesées ont été effectuées tous les quinze jours, afin de déterminer le GMQ. Les pesées des aliments ingérés pour la détermination du IC ont été faites avec la même périodicité. Tous les mois, l'épaisseur de la graisse dorsale et la profondeur du muscle* longíssimus dorsi *ont été par ailleurs mesurées par échographie. Les animaux ont été abattus avec ±100 kg de poids vif et âgés de dix mois. Après l'abattage, les carcasses ont été découpées de façon à évaluer : le % de pièces nobles ; les ratios adipeux/musculaire et muscle/os. En comparant les génotypes on observe que le GMQ a été significativement supérieur (*P*<0,01) pour les animaux croisés alors que les différences entre IC n'ont pas été significatives. Concernant l'effet de l'alimentation, le régime A entraîne un GMQ supérieur (*P*<0,001) et des IC plus grands (*P*<0,001). L'interaction génotype x régime a été significative pour les deux paramètres (*P*<0,01). Au moment de l'évaluation des carcasses nous avons noté une proportion de muscle et pièces nobles, supérieure chez les croisés par rapportaux Alentejanos (*P*<0,001) et logiquement une proportion de graisse inférieure (*P*<0,001). Le régime a affecté significativement (*P*<0,05) le % de graisse, la surface des lombes, ainsi que le poids d'os. Les différences n'ont pas été significatives pour l'interaction génotype x régime.*

Mots-clés : *Race Alentejana, régimes d'exploitation, caractéristiques de la carcasse.*

Introduction

The seasonal variability of acorn production, and the moderate growth of Alentejano breed pigs, make the production cycles very long. Traditionally, the spring pasture and the stubble from summer support some of the basic needs of growing pigs, but the new agricultural practices tend to reduce planted areas. The ruminants, with an ever higher population densities leave very little available grassland. The alternative is to use efficient diets, according to the physiological needs of the breed and the objectives of the herd, at low cost. This should be done for growing and pre-finishing pigs before putting out to pasture.

The objective of this work was to evaluate two diets on pure Alentejano and cross-bred Alentejano pigs, one based on triticale corrected with lysine and premix, and the other a composite commercial feed. The influence on growth and the characteristics of carcass before putting out to pasture under oak canopy as well as the economical feasibility of each diet were assessed.

Material and methods

Animals. A total of 48 sexually neutralized male and female animals were used, 24 of Alentejano breed and 24 cross-breed (LW x DUROC) x AL, approximately five months old and 31.1 kg in weight, which were divided into 4 groups of 12 animals: (i) Alentejano, fed with triticale; (ii) Alentejano, fed with commercial feed; (iii) Cross-breed, fed with triticale; and (iv) Cross-breed, fed with commercial feed.

Identification. All the animals carried a permanent electronic identification system. Microchips had been placed in their hock after weaning.

Housing. The animals were housed in individual cells, with automatic feeding and drinking equipment, making it thus possible to have a controlled individual feeding system.

Feeding. Two daily diets were used: Diet A - Balanced commercial feed (see annex). Diet T - Triticale with premix and lysine supplements (see annex).

The daily amount of feed supplied was adjusted every fortnight according to need (INRA tables, 1987) to a maximum of 3.1 kg/animal per day, distributed as a single daily meal.

Measurements with live animals. The animals were weighed every fortnight in order to asses the following productive parameters: ADG and CI. The loin fat and the thickness of the *longíssimus dorsis* muscle were measured monthly, using echography.

Slaughter. The animals were slaughtered in the Beja slaughterhouse at ±100 kg, with current methods (electronacrosis, vertical bleeding, scalding and depilation), and the carcasses were dissected in the Barrancarnes transformation company.

Post-mortem measurements

Carcass weight: warm weight immediately after slaughter.

Carcass length: was measured on the inner side of the half carcass, from the cranial face of atlas to the edge of ischium exposed by the sagittal cutting of half-carcass.

Carcass yield: was determined as a percentage, dividing the weight of the carcass minus two percent, by live weight minus five percent.

Muscle weight: was determined by adding the amount of muscle obtained by dissecting the half-carcass.

Bone weight: was determined by adding the amount of bone obtained by dissecting the half carcass.

Fat weight: was determined by adding the amount of fat obtained by dissecting the half carcass.

Loin area: the area of *longissimus dorsis* at the last rib was determined using a planimeter with the surface traced on transparent paper.

Thickness of loin fat: the measurements of lumbar fat were carried out at the following points: last lumbar vertebrate, first lumbar vertebrate and last rib on the medial line and at 2, 4 and 6 cm from it.

Statistical analysis

For analysing the fixed non-linearized factors, analysis of variance was carried out with the "Mixed Model Least-Squares and Maximum Likelihood Computer" programme, Harvey (1990). The general mathematical models were as follows:

ADG and CI

$$Y_{ijk} = \mu + Gen_i + Reg_j + (Gen * Reg)_{ij} + b\,(P - P) + \in_{ijk}$$

Carcass

$$Y_{ijk} = \mu + Gen_i + Reg_j + (Gen \times Reg)_{ij} + b'\,(Pc - Pc) + \in_{ijk}$$

Y_{ijk} = Observed response for each dependent variable.
μ = Common average effect.
Gen_i = Fixed effect of genotype (i = 1.2).
Reg_j = Fixed effect of diet (J = 1.2).
$(Gen \times Reg)_{ij}$ = Interaction of genotype $_i$ x diet $_j$.
b - Covariant regression for the weight at slaughter.
b' - Covariant regression for carcass weight.

Results

Statistically significant differences were observed between the genotypes (P<0.01). Regarding ADG, genotype AL presented a significant difference in favour of diet T, while significant differences between diets in crossed animals were not observed. The total amount of feed intake was significantly different (P<0.001) between the diets and between the genotypes within each diet. Regarding CI, there were only significant differences between AL animals fed with commercial feed and the others. Although there were differences between the thickness of lumbar fat at the end of growth, with greater fat layers in animals fed with Triticale and of AL genotype, these differences were not statistically significant (P>0.05) neither between the genotypes nor between the diets (Table 1).

Table 1. Comparison of productive parameters (average, least square) in function of genotype and feed[†]

GEN	REG	PES I	PEAB	AMAT	GMDT	ALI	IC	EGD
AL	T	31.3	102.0±1.4	70.7±1.4	503±11[a]	298.0±4.2[a]	4.2±0.1[a]	30.6±1.9
	A	31.3	94.0±1.4	62.6±1.4	438±11[b]	336.7±4.2[c]	5.4±0.1[b]	27.3±2.2
CRUZ	T	31.3	104.2±1.4	72.9±1.4	523±11[c]	345.0±4.2[b]	4.8±0.1[a]	27.2±2.4
	A	31.3	100.4±2	69.1±1.4	525±11[c]	325.8±4.2[d]	4.7±0.1[a]	23.5±1.6
	NS		NS	NS	P<0.01	P<0.001	P<0.001	NS

[†]GEN: Genotype; AL: Alentejano; CRUZ: Crossed; REG: Feed diet; T: Triticale; A: Commercial feed; NS: Level of significance; PES I: Initial corrected weight (kg); PEAB: Weight at slaughter (kg); AMAT: Total body weight gain (kg); GMDT: Total daily weight gain (g); ALI: Total feed intake (kg); IC: Conversion index; EGD: Lumbar fat thickness (mm).

In the assessed parameters of carcass, significant differences were observed between genotypes in carcass length (*P*<0.05), and in the thickness of lumbar fat. Between diets no differences were observed in carcass length (*P*>0.05), although there were significant differences (*P*<0.05) in the remaining parameters (Table 2).

Table 2. Comparison of parameters assessed in the carcass between genotypes and diets (X ± EPX)[†]

GEN	REG	RCAR	COMP	UC2	UC4	UC6	SLO
AL	T	80.5±0.5	96.4±1.6[a]	54.2±4.0[a]	60.2±4.9[a]	58.6±4.5[a]	24.1±2.6[a]
	A	79.4±0.6	97.8±1.9[a]	39.4±4.7[c]	45.0±5.8[c]	43.7±5.3[a]	31.8±3.1[b]
CRUZ	T	79.2±0.7	100±2.1[b]	42.3±5.2[b]	42.1±6.5[b]	39.6±5.9[b]	30.1±3.4[b]
	A	80.8±0.5	101±1.4[b]	29.9±3.5[d]	30.4±4.54[d]	32.1±4.0[b]	40.3±2.3[c]
	NS	NS	*P*<0.05	*P*<0.05	*P*<0.01	*P*<0.05	*P*<0.05

[†]GEN: Genotype; AL: Alentejano; CRUZ: Crossed; REG: Feed diet; T: Triticale; A: Commercial feed; NS: Level of significance; RCAR: Carcass yield; COMP: Carcass length; UC: Thickness of fat at the medial line (2, 4 and 6 cm); SLO: Lumbar surface

Significant differences were observed in the yield of lean pieces and in the weight of rump, with the cross-bred animals showing quantitative superiority in the above mentioned parameters. The diet did not significantly affect either the yield of lean meat nor the weight of rump. The tissue relations presented significant differences: between genotypes (*P*<0.01) in muscle weight; between diets (*P*<0.01) in bone weight and between genotypes and diets (*P*< 0.01) in fat weight (Table 3).

Table 3. Comparison of tissue composition in function of genotype and diet (X EPX)[†]

GEN	REG	PN	PLB	PESM	PESO	PESG
AL	T	12.3±0.5[a]	10.0±0.4[a]	12.5±0.7[a]	4.6±0.2[a]	17.4±0.6[a]
	A	14.4±0.6[ab]	11.2±0.5[a]	14.6±0.8[a]	5.5±0.2[b]	15.2±0.7[b]
CRUZ	T	15.3±0.7[b]	12.2±0.5[b]	16.8±0.9[b]	4.8±0.2[a]	14.7±0.8[c]
	A	16.0±0.4[b]	12.7±0.4[b]	17.0±0.6[b]	5.6±0.1[b]	13.0±0.5[d]
	NS	*P*<0.05	*P*<0.01	*P*<0.01	*P*<0.01	*P*<0.05

[†]GEN: Genotype; AL: Alentejano; CRUZ: Crossed; REG: Feed diet; T: Triticale; NS: Level of significance; PN: Weight of lean meat (kg); PLB: Weight of rump (kg); PESO: Weight of bone (kg); PESG: Weight of fat (kg)

Discussion

The purpose of cross-breeding is to take advantage of the complementarily of breeds and of hetrosis (Séllier, 1986). Thus, as long as the animals satisfy their nutritious needs, the cross-bred animals are expected to be superior to those of pure breed. The observed values of ADG, feed intake, CI and lumbar fat thickness are in agreement with the results obtained by other authors in relation to autochthonous breeds and their cross-breeding with improved breeds (Dobao, *et al.,* 1989; Sierra and Sanudo, 1989; Santuci *et al*., 1991; Nunes, 1993).

In the assessments at the level of carcass, the greater bodily development of the cross-bred animals and the greater fat tissue in the animals of Alentejanoo breed is in agreement with other works of Portuguese (Frazão, 1984; Nunes, 1993; Freitas, 1998) and Spanish authors (Dobao *et al.,* 1987; de Pedro *et al.,* 1989; Sierra and Sanudo, 1989). In the animals fed with triticale, greater adiposity and a smaller percentage of bone in carcass were observed, which led to significantly different adipo/muscular relations and musculature grades according to the diet. This evidence can be justified by deficiencies in gross protein content of triticale (annex) and of Calcium/Phosphorus of the premix used (annex).

References

De Pedro, E.J., Grace de Siles, J.L., Dobao, M.T., Rodrigañez, J. and Silio, L. (1989). Crescimiento relativo de diferentes cortes y tecidos de la canal de cerdo Ibérico. *Colloque International sur la Production Porcine en Europe Méditerranéenne*, Ajacio, 14-16 Nov.

Dobao, M.T., Rodrigañez, J., Silio, L. and Toro, M.A. (1989). Valoracion del cruzamiento entre las razas Jiaxing e Ibérica. *Colloque International sur la Production Porcine en Europe Méditerranéenne,* Ajacio, 14-16 Nov.

Dobao, M.T., Rodrigañez, J., Silio, L., Toro, M., De Pedro, E. and García de Siles, J.L. (1987). Crecimiento y caracteristicas de canal en cerdos Ibéricos, Duroc –Jersey x Ibérico y Jiaxing x Ibérico. *Inv. Agrar.: Prod. Sanid. Anim.,* 2(1).

Frazão, T.L. (1984). O porco alentejano melhorado. *Boletim Pecuário*, Ano XL, pp. 13-75.

Freitas, A.B. (1998). *Influência do nível e regime alimentar em pré-acabamento sobre o crescimento e desenvolvimento do porco Alentejano e suas repercussões sobre o acabamento em montanheira e com alimento comercial*. PhD Thesis, Universidade de Evora.

Nunes, J.L.T. (1993). *Contributo para a reintegração do porco alentejano no montado*. PhD Thesis, Universidade de Evora.

Santuci, P.M., Bernard, E., Casabianca, F., Luciani, A., Gandemer, G., Coutron, C. and Secondi, F. (1991). Influence du rationnement en pre-finition sur l'engraissement du porc charcutier fini a la châtaignes. *II Coloquio sobre el Cerdo Mediterráneo*, Badajoz, 25, 26 and 27 March.

Séllier, P. (1986). Amérolation génétique. In: *Le Porc et son Elevage (Bases Scientifiques et Techniques).* Maloine S.A. (Ed.), Paris, pp. 159-226.

Sierra, I. and Sanudo, C. (1989). Cruzamientos y produccion intensiva en el cerdo Ibérico: I. Resultados reproductivos y productivos. Nuevos sistemas de producción. *Colloque International sur la Production Porcine en Europe Méditerranéenne*, Ajacio, 14-16 Nov.

Annex

Triticale composition (average)

Gross energy (Kcal/kg)	Dry matter (%)	Nitrogen free extract (%)	Ether extract (%)	Crude fiber (%)	Crude protein (%)	Mineral s (%)
3770	86	68.3	1.6	2.7	11.6	1.8

Prémix composition: Vit A 3300000 U.I.; Vit D3 670000 U.I.; Vit E 3300 mg; Vit K3 670 mg; Vit B2 1300 mg; Nicotinic acid 3300 mg; Pantothenic acid 3300 mg; Fe 30000 mg; Cu 33700 mg; Mg 5300 mg; Zn 26600 mg; Iodo 160 mg; Co 130 mg; Se 30 mg; Choline 45 g; Excipient q.b.p. 1000 g

Commercial feed composition

Digestible energy (Kcal)	Crude protein (%)	Ether extract (%)	Crude fiber (%)	Minerais (%)	P (%)	Ca (%)	Lysine (%)
3000	14	2.3	5.7	6.8	0.6	0.85	0.76