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Effect of Duroc genes proportion on growth performance and on carcass and meat quality characteristics in heavy pigs

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ABSTRACT

By means of the application of covariance models, the linear effects of the proportion of Duroc genes were evaluated with respect to growth (from 6 to 170 kg live weight) and feed/gain ratios, as well as carcass (lean cuts, adipose cuts, linear measures, backfat thickness, loin area and lean percentage) and meat quality ($L^* a^* b^*$ colour, reflectance, electrical conductivity, pH) in 167 heavy pigs (87 castrated males, 80 females) from different crosses of Duroc (D), Large White (LW) and Landrace (L) breeds, from 25 to approximately 300 d of age. The pigs were weighed at 25, 105, 170, 235 d and at the end of the trial (298 ± 6 d of age), and were raised under the same conditions. The proportion of Duroc genes was 0% (LWxL; n. 33), 25% [(LWxDxL); n. 31 and Lx(DxLW); n. 35] and 50% [Dx(LWx(LWxL)); n. 68]. The increase in the proportion of Duroc genes negatively affected the live weight at the different ages ($P < 0.05$), but the weight at slaughtering was not affected ($P > 0.10$). In fact, during the final phase (from 120 to 170 kg l.w.) the effect of the Duroc breed on daily gain became positive ($P = 0.08$), and the feed/gain ratios were significantly lower ($P = 0.02$). The carcass composition was not significantly influenced by the increase in the proportion of Duroc genes, with the exception of a rise in the weight of neck ($P < 0.01$) and flare fat ($P = 0.02$) and a reduction of ham ($P = 0.09$). Carcass length resulted lower as the proportion of Duroc genes increased ($P < 0.01$); at 24 h from slaughtering, meat colour showed lower values for lightness ($P = 0.08$), redness ($P = 0.02$) and yellowness ($P = 0.03$).

Key words: Swine, Duroc, Carcass, Meat, Crossbreeding.

RIASSUNTO

INFLUENZA DELLA PERCENTUALE DI GENI DELLA RAZZA DUROC SULLE PERFORMANCE DI ALLEVAMENTO E SULLA QUALITÀ DELLA CARCASSA E DELLA CARNE NEL SUINO PESANTE

Sono stati valutati, attraverso l'applicazione di modelli di analisi della covarianza, gli effetti della percentuale di geni della razza Duroc sulle prestazioni di allevamento (incremento ponderale giornaliero, indice di conversione) e sulla qualità delle carcasse (tagli magri, tagli adiposi, misure lineari, spessore del grasso, area del muscolo l.dorsi, percentuale di carne magra) e delle carni (colore, grado di rifrazione della luce, conducibilità elettrica, pH) di 167 suini pesanti (87 maschi castrati, 80 femmine), appartenenti a diversi incroci, alla cui formazione hanno partecipato le razze Duroc (D), Large White (LW) e Landrace (L), allevati da 25 d di età a circa 300 d (peso di macellazione 170 kg). La quota di geni della razza Duroc era pari allo 0% (LWxL; n. = 33), al 25% [(LWxDxL); n. = 31 e Lx(DxLW); n. = 35] e al 50% [Dx(LWx(LWxL)); n. = 68]. L'aumento della proporzione di geni della razza Duroc porta verso una riduzione significativa del peso vivo a tutte le età ($P < 0,05$), fatta eccezione per il peso alla macellazione ($P > 0,10$). Infatti, nell'ultimo periodo

di allevamento (da 236 d alla macellazione) l'effetto della razza sugli incrementi ponderali diventa positivo (+6,1 g/d ogni 10% di incremento della quota di geni Duroc; $P=0,08$); nel medesimo periodo gli indici di conversione tendono ad essere significativamente più bassi (-11 g SS/kg IPG; $P=0,02$).

La composizione della carcassa risulta scarsamente influenzata dall'aumento della quota di geni della razza Duroc, se si eccettua una lieve riduzione del peso del prosciutto (-0,061 kg; $P=0,09$) ed un aumento del peso della coppa (+0,100 kg; $P<0,01$) e della sugna (+0,050 kg; $P=0,02$). Le carcasse sono inoltre tendenzialmente più corte (risp. -0,564 e -0,326 cm per la distanza fra il margine craniale sella sinfisi pubica e l'articolazione occipito-atlantoidea o il margine craniale della 1a costa; $P<0,01$); il colore delle carni dopo 24 h dalla macellazione mette in evidenza valori più bassi di luminosità (-0,187; $P=0,08$) e di indice del rosso (-0,154; $P=0,02$) e del giallo (-0,111; $P=0,03$).

Parole chiave: *Suini, Duroc, Carcassa, Carne, Incrocio*

Introduction

Swine production in Italy is mainly orientated to the production of heavy pigs for industry and characterised, therefore, by the need to achieve high slaughtering weights while maintaining a correct adiposity. The use of crossbreeding is frequent, and makes it possible, first of all, to exploit heterosis for some traits with a low heritability, and, secondly, to use trait complementarity. In the last twenty years the Duroc breed, of American origin, has been added to the traditionally employed breeds (Large White and Landrace). The effects of this breed, with respect to the impact on a swine production with different features from the original ones, have been the object of numerous studies (Fabbri and Bergonzini, 1979; Santoro *et al.*, 1981; Bergonzini and Fabbri, 1981; Geri *et al.*, 1983; Bittante *et al.*, 1989, 1990, 1991; Caleffi and Broccaioli, 1990; Bonomi *et al.*, 1991 and 1992; Franci *et al.*, 1994a and 1994b). The results obtained are, in general, favourable to the use of such a breed in crossbreeding for the production of the heavy pigs and for the industrial transformation of meat. Nevertheless, the variability of the results, in relation to the breeds used in the crosses and in the degree of employment of the Duroc breed, makes it extremely difficult to extrapolate the contribution of the latter.

Recently, Blanchard *et al.* (1999) carried out a study on the contribution of the Duroc breed in the production of pigs slaughtered at 90 kg. In the conclusions they affirmed that the use of this breed in crosses does not influence the performance *in vivo*, but the quality of carcass results fatter in the

crosses with 50% Duroc genes and meat appears darker.

Since such results are not directly applicable to Italian swine production because of the different implications, in particular the high weight of slaughtering, a study was carried out, with the aim to appraise the effects of the Duroc breed in the production of heavy pigs.

Material and methods

The trial was conducted on 167 heavy pigs (87 castrated males and 80 females), belonging to different crosses of Duroc (D), Large White (LW) and Landrace (L) breeds, bred from 26 sows mated to 15 unrelated boars. The percentage of the Duroc breed was equal to 0% (LWxL; no. 33), to 25% [(LWx(DxL); no. 31 and Lx(DxLW); no. 35)] and to 50% [Dx(LWx(LWxL)); no. 68]. The experimental protocol initially contemplated the presence of a group of Dx(Lx(LxLW)) that would have made it possible to mediate the effects of the other breeds in the group of pigs with 50% Duroc genes, however, due to technical reasons, this group was not included. This absence surely determined a different contribution of the other breeds, limitedly to the last group.

Animals were submitted to the same rearing conditions; after weaning, at the age of 25 d, they were individually marked and transferred to transition boxes until 105 d of age. After this period, during which they were fed *ad libitum* with meal feeds, they were placed in ten contiguous boxes and fed a wet ration (milk serum/water/meal ratio equal to 2/1/1) distributed twice a day. Every

month the ration was adapted to the theoretical requirements of the animals (Bonomi and Sabbioni, 1987); the chemical composition of the feeds is reported in table 1. The animals were weighed individually at the beginning and at the end of the cycle, as well as at 105, 170 and 235 d of age. The measurements on the feed intake were carried out per box, only during the fattening phase (from 105 d to slaughtering). The animals were slaughtered at 298 ± 6 d of age, during three different sessions; in each session a representative number of animals from the four genetic types were slaughtered.

At slaughtering the weight of the head, of the thoracic organs and of the half sides were determined on each carcass and an estimate was made of the percentage of lean meat and of the *longissimus dorsi* (LD) area, on the right side. This was completed by means of the Destron PG100, between the last three-four ribs, 8 cm from the middle line. Other measurements were conducted on the right side to determine the fat thickness, by means of callipers, in correspondence of the regions of the shoulder (greatest value), of the back (smaller value) and of the loin (mean of three measures). The length of the carcass was determined with a tape-measure (from cranial margin of pubic symphysis to atlanto-occipitalis joint and to cranial margin of 1st rib). The colour, the light reflectance, the electrical conductivity and the pH of the semimembranosus (SM) muscle were recorded at 45 min post mortem. These latter measurements were repeated after 24 h on

the left side. In particular, on the fresh cut of the SM muscle, the surface colour was measured by means of a Minolta Chromameter Reflectance II CR100/08, using channel 1, which contains a calibration with a Standard Gardner pink tile no.CG6625 ($Y=45.97$; $x=0.3658$; $y=0.3250$). Four measurements were made in different points of each ham. They have been expressed as $L^* a^* b^*$ (Novelli *et al.*, 1991). The values of hue and chrome were calculated as $\arctg(b/a)$ and $\sqrt{(a^2+b^2)}$, respectively. Light reflectance and electrical conductivity, were determined using the Fiber Optic Probe (FOP) and the conductimeter LF 191, respectively, and were carried out introducing the probe in 2 points with direction parallel to muscular fibres. For pH determination, a sample of muscle was withdrawn (50-100 g), then fat and *epimysium* were removed, and the sample was then homogenised by means of Ultra Turrax, using, at 45 min *post mortem*, a 0.01 M solution of iodoacetic acid and 0.15 M KCl buffered to pH 7 (ratio 1/10 muscle/solution) and, at 24 h, distilled water.

The right side was hot dissected by the same personnel, to establish the incidence of the different cuts.

Raw data were elaborated according to the least squares method (SPSS, v.10.0.6, 1999), using the following models of covariance analysis:

model 1: for data concerning live weight and daily weight gain:

$$y_{ij} = m + S_i + b_I X_{Iij} + e_{ij}$$

Table 1. Chemical composition of complete feeds.

Period		From 25 to 105 d	From 106 to 170 d	From 171 to 235 d	From 236 d to slaughter
Moisture	%	11.93	12.95	12.97	13.15
Ash	"	6.03	5.78	5.53	5.18
Crude protein	"	17.18	15.37	14.40	13.39
Ether extract	"	5.00	3.34	3.50	2.65
Crude cellulose	"	3.30	4.18	4.04	3.96
N-free extract	"	56.56	58.38	59.56	61.67
Lysine	"	1.09	0.70	0.62	0.54
Digestible Energy	kcal/kg	3150	3005	3027	3002

model 2: for data concerning feed/gain ratio:

$$y_i = m + b_1 X_{1i} + e_i$$

model 3: for data concerning carcass weight and slaughtering yield:

$$y_{ijk} = m + S_i + M_j + b_1 X_{1ijk} + e_{ijk}$$

model 4: for data concerning carcass and meat parameters:

$$y_{ijk} = m + S_i + M_j + b_1 X_{1ijk} + b_2 X_{2ijk} + e_{ijk}$$

where:

- y individual observation;
 m overall mean;
 S_i fixed effect of sex (i = 1,2);
 M_j fixed effect of session of slaughtering (j = 1,...,3);
 b₁ regression coefficient with percentage of Duroc breed genes (X₁); for the independent variable a scale was used such that the

regression coefficient was expressed as the variation of the dependent each 10% more genes of the Duroc breed;

- b₂ regression coefficient with carcass weight (X₂, kg);
 e error term.

Results and discussion

The effects of an increase in the percentage of Duroc genes on growth performance are reported in table 2. Except for the value at slaughter (P>0.10), a negative effect of the breed on live weight (P<0.05) can be noted. In fact, in the final period of the cycle (from 120 to 170 kg) the effect of the contribution of the Duroc breed on daily gain became positive (P=0.08). In the same period, the food/gain ratios improved with the increase of the percentage of Duroc genes (P=0.02).

Franci *et al.* (1994a) have noted a better daily weight gain in pigs derived from Duroc boars mated with LW sows and slaughtered at 160 kg,

Table 2. Live weight, average daily gain (ADG) and feed/gain ratio (least-squares means \pm SE). Linear effect of 10% increases in Duroc genes percentage (regression coefficients, b₁ \pm SE).

		Overall mean \pm SE	b ₁ \pm SE	P	RSD
Live weight:					
at 25 d	kg	6.11 \pm 0.07	-0.128 \pm 0.039	0.00	1.138
at 105 d	"	32.41 \pm 0.30	-0.872 \pm 0.163	"	4.605
at 170 d	"	68.53 \pm 0.61	-1.097 \pm 0.325	"	8.187
at 235 d	"	120.03 \pm 0.99	-1.266 \pm 0.526	0.02	13.088
at slaughter	"	171.06 \pm 1.33	-1.012 \pm 0.704	NS	17.056
ADG:					
from 25 to 105 d	g/d	329 \pm 3	-9.2 \pm 1.9	0.00	54
from 106 to 170 d	"	544 \pm 8	-4.1 \pm 4.2	NS	105
from 171 to 235 d	"	787 \pm 11	-4.1 \pm 5.8	"	142
from 236 d to slaughter	"	777 \pm 16	6.1 \pm 4.8	0.08	201
from 106 d to slaughter	"	707 \pm 6	-0.7 \pm 3.4	NS	81
Feed/gain ratio:					
from 106 to 170 d	g DM/kg ADG	2961 \pm 31	7.2 \pm 1.7	0.00	121
from 171 to 235 d	"	3308 \pm 79	0.4 \pm 4.2	NS	305
from 236 d to slaughter	"	3968 \pm 74	-11.0 \pm 4.0	0.02	288
from 106 d to slaughter	"	3493 \pm 27	0.8 \pm 1.4	NS	103

NS: P>0.10.

than in pigs derived from LW boars, while the feed/gain ratios were not significantly different. Nevertheless, it must be noted that, in the cited paper, the feed/gain ratios were not calculated for each phase, but for the whole cycle, and therefore the authors were not able to show a possible positive effect in the last period. Data from other studies do not help to interpret the results obtained, since they refer, on the whole, to animals slaughtered at lower weights. For example, Liu *et al.* (1999) report no significant differences in growth and feed/gain ratios of Duroc, LW and L pigs, purebred or crossbred, slaughtered at 100 kg l.w.. Blanchard *et al.* (1999) report no significant differences for the weight gain of pigs with percentages of Duroc genes equal to 0%, 25% and 50% and slaughtered at approximately 90 kg. Moreover, animals with 50% Duroc genes have shown a slightly greater feed/gain ratio (2%). Comparing the performance of the progeny of LW or Duroc boars,

slaughtered at approximately 80 kg, Simpson *et al.* (1987) did not show differences between breeds if feed was rationed. If feed was supplied *ad libitum*, pigs from Duroc boars grew faster and presented more favourable feed/gain ratios. McGloughlin *et al.* (1988) have shown better performance during the growing phase in pigs from Duroc boars than from LW and L. Up to a slaughtering weight of 86 kg, the former have shown better daily gains (5%) and feed/gain ratios (4%).

The carcass weight and the weight of the main lean and adipose cuts, as well as the carcass, lean and adipose cuts yields are reported in table 3. The carcass weight does not vary significantly ($P>0.10$) in relation to the percentage of Duroc genes, as well as the sum of the lean cuts (ham, shoulder, loin, neck) and of the adipose ones (flare fat, belly, backfat, jowl). Nevertheless, considering the individual cuts, the increase in the contribution of Duroc genes determines a reduction in the weight

Table 3. Weight of carcass, lean and fatty cuts and yield (least-squares means \pm SE). Linear effect of 10% increases in Duroc genes percentage (regression coefficients, $b_1 \pm$ SE).

		Overall mean \pm SE	$b_1 \pm$ SE	P	RSD
Carcass	kg	135.64 \pm 1.02	-0.535 \pm 0.617	NS	12.901
Dressing percentage	%	79.57 \pm 0.20	-0.307 \pm 0.123	0.01	2.558
Remarks on right side:					
Ham	kg	16.36 \pm 0.06	-0.061 \pm 0.036	0.09	0.747
Shoulder	"	8.42 \pm 0.05	-0.006 \pm 0.033	NS	0.681
Loin	"	9.98 \pm 0.08	-0.069 \pm 0.046	"	0.950
Neck	"	4.35 \pm 0.04	0.100 \pm 0.021	0.00	0.447
Lean cuts	"	39.11 \pm 0.15	-0.037 \pm 0.091	NS	1.906
Flare fat	"	2.20 \pm 0.03	0.050 \pm 0.021	0.02	0.428
Belly	"	7.75 \pm 0.06	-0.015 \pm 0.037	NS	0.771
Backfat	"	7.67 \pm 0.11	0.024 \pm 0.067	"	1.406
Jowl	"	4.37 \pm 0.03	0.021 \pm 0.019	"	0.389
Fat cuts	"	21.93 \pm 0.16	0.072 \pm 0.095	"	1.973
Head	"	6.13 \pm 0.04	0.008 \pm 0.022	"	0.463
Feet	"	1.24 \pm 0.01	0.002 \pm 0.005	"	0.099
Trimming	"	5.02 \pm 0.16	0.015 \pm 0.098	"	2.036
Lean cuts / fat cuts		1.815 \pm 0.017	-0.006 \pm 0.010	"	0.216
Lean cuts yield	%	58.27 \pm 0.23	-0.087 \pm 0.140	"	2.915
Fat cuts yield	"	32.48 \pm 0.23	0.081 \pm 0.137	"	2.867

NS : $P>0.10$.

Table 4. Carcass measurements (least-squares means \pm SE). Linear effect of 10% increases in Duroc genes percentage (regression coefficients, $b_1 \pm$ SE).

		Overall mean \pm SE	$b_1 \pm$ SE	P	RSD
Lean meat	%	47.41 \pm 0.22	0.046 \pm 0.134	NS	2.765
Loin area	cm ²	52.11 \pm 0.58	-0.145 \pm 0.344	"	7.033
<i>Carcass length:</i>					
1 st measurement (*)	cm	111.48 \pm 0.24	-0.564 \pm 0.147	0.00	3.062
2 nd measurement (**)	"	93.59 \pm 0.18	-0.326 \pm 0.109	"	2.270
<i>Backfat thickness:</i>					
at shoulder (maximum)	cm	5.63 \pm 0.05	0.095 \pm 0.032	0.00	0.664
at back (minimum)	"	3.33 \pm 0.05	0.032 \pm 0.028	NS	0.581
at loin (mean of 3 measures)	"	3.06 \pm 0.04	-0.017 \pm 0.026	"	0.551

(*): from cranial margin of pubic symphysis to atlanto-occipitalis joint.

(**): from cranial margin of pubic symphysis to cranial margin of 1st rib.

NS: $P > 0.10$.

of ham ($P=0.09$) and an increase in the weight of neck ($P < 0.01$) and flare fat ($P=0.02$).

The carcass measurements are reported in table 4. The percentage of lean meat and LD muscle area are not significantly affected by Duroc breed percentage ($P > 0.10$). The same breed however produces shorter carcasses ($P < 0.01$), both for the measurement from the cranial margin of pubic symphysis to the atlanto-occipitalis joint, and from the cranial margin of pubic symphysis to the cranial margin of 1st rib. The relieves on lard show that its weight is rising ($P > 0.10$) in relation to an increase in the percentage of Duroc genes (table 3), and that the thickness appears significantly changed ($P < 0.01$), only in correspondence of the measurements at shoulder level (table 4).

Data reported in tables 3 and 4 are partially in agreement with those of McGloughlin *et al.* (1988); they have reported no differences in fat thickness in the progeny of Duroc boars, compared to that of LW and L boars, nor in the slaughtering yield. Moreover, the Duroc boars have shown a significant reduction in carcass length and flare fat weight, while the LD muscle area did not show significant variations. The reduction in carcass length tied to the presence of Duroc genes, as well as a limited effect on carcass fat content, has been shown also by Simpson *et al.* (1987). Blanchard *et*

al. (1999), instead, have noted an increase of adiposity, as the contribution of Duroc genes increased, with differences not only on subcutaneous fat, but also on intramuscular fat. The absence of a significant effect on carcass adiposity, shown in part by this study, could be explained by the different weight at slaughtering reached by the pigs in the two trials (90 vs 170 kg). So, the effect of the Duroc breed on adiposity would result more intense in correspondence to the lowest slaughtering weight, and it would confirm what was previously hypothesised about the suitability of the breed as regards the achievement of high final weights. Franci *et al.* (1994b) have put in evidence a higher content of lean cuts and a lower content of adipose cuts in the carcasses obtained from DxLW crosses, than from LxLW, without evidence of a significant interaction between genetic type and class of weight.

At the SM muscle level at 24 hours from slaughtering (table 5), the increase of the contribution of the Duroc breed genes shows lower values for lightness (L^*) ($P=0.08$), redness (a^*) ($P=0.02$) and yellowness (b^*) ($P=0.03$); also other parameters that describe the colour changed in a significant way (increase of the hue after 45 min from slaughter, reduction of chrome after 24 h). The electrical conductivity ($P=0.01$) and the pH

Table 5. Colour, reflectance, electrical conductivity and pH of semimembranosus muscle (least-squares means \pm SE). Linear effect of 10% increases in Duroc genes percentage (regression coefficients, $b_1 \pm$ SE).

	Overall mean \pm SE	$b_1 \pm$ SE	P	RSD
Reliefs on the right ham at 45 min post mortem				
- L*	42.63 \pm 0.18	0.093 \pm 0.106	NS	2.193
- a*	7.80 \pm 0.11	-0.099 \pm 0.064	"	1.322
- b*	2.81 \pm 0.05	0.040 \pm 0.030	"	0.616
- hue	0.35 \pm 0.01	0.009 \pm 0.004	0.03	0.089
- chrome	8.33 \pm 0.10	-0.075 \pm 0.061	NS	1.263
- a*/b*	2.96 \pm 0.07	-0.067 \pm 0.045	"	0.932
- reflectance	25.18 \pm 0.38	0.346 \pm 0.231	"	4.825
- electrical conductivity	3.42 \pm 0.05	-0.085 \pm 0.031	0.01	0.644
- pH	6.77 \pm 0.01	0.027 \pm 0.007	0.00	0.150
Reliefs on the left ham at 24 h post mortem				
- L*	45.92 \pm 0.26	-0.187 \pm 0.103	0.08	3.320
- a*	8.91 \pm 0.11	-0.154 \pm 0.068	0.02	1.375
- b*	4.74 \pm 0.08	-0.111 \pm 0.051	0.03	1.029
- hue	0.49 \pm 0.01	-0.003 \pm 0.004	NS	0.071
- chrome	10.14 \pm 0.12	-0.190 \pm 0.076	0.01	1.557
- a*/b*	1.97 \pm 0.03	0.009 \pm 0.018	NS	0.361
- reflectance	41.68 \pm 0.58	0.252 \pm 0.355	"	7.255
- electrical conductivity	4.40 \pm 0.19	-0.161 \pm 0.114	"	2.322
- pH	5.59 \pm 0.01	0.005 \pm 0.006	"	0.115

NS: $P > 0.10$.

($P < 0.01$) at 45 min *post mortem* changed, respectively in negative and positive sense, as Duroc genes increased, confirming the good features of meat for transformation.

Also Blanchard *et al.* (1999) reported that pigs with 25% and 50% of Duroc breed genes have shown meats (LD muscle) significantly darker than those of the so-called "white breeds", while the degree of light refraction and the pH were not different. Huiskes *et al.* (1997), instead, have not indicated differences in meat pH and colour in pigs with percentages of Duroc genes equal to 0% and 25%.

Conclusions

The results of the study, carried out with the aim to quantify the effects of the presence of the Duroc breed on the main *in vivo* parameters and

on carcass and meat quality in heavy pigs, reinforce the interest for this breed in the context of Italian swine production, but highlight some peculiarities, tied to the use of this breed in crosses.

The breed does not offer significant advantages with regard to *in vivo* performances, except on the daily gain and feed/gain ratio in the final phase of the fattening. Since this period is normally characterised by a reduction of growth and by a strong fat deposition, it is possible to hypothesize an advantage deriving from the use of the Duroc breed, if animals are slaughtered at high weights.

The variations bound to carcass composition are of less interest, and can be summed up as a slight increase in neck and flare fat weight and in a slight reduction of the ham weight. In terms of yield of total lean and adipose cuts, the linear variations linked to the use of the Duroc breed do not result significant.

With regard to meat quality, it has been confirmed that the Duroc breed produces darker meat. From the point of view of transformation, the data regarding electrical conductivity and pH immediately after slaughtering make it possible to hypothesise a favourable impact with processing technologies.

In conclusion, we therefore can affirm that the Duroc breed, used in crosses, offers a positive contribution to the production of Italian heavy pigs, by means of an enhancement of their growth and of the efficiency of food transformation in the fattening phase. Moreover, crossbreeds with Duroc genes also result in the production of carcasses with correct ratios between lean and adipose cuts and have an impact on meat quality that is not in contrast with the requirements of the transformation into typical products.

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