



Morphological traits, reproductive and productive performances of Casertana pigs reared outdoors

Emilio Pietrolà¹, Fabio Pilla², Giuseppe Maiorano², Donato Matassino³

¹Parco Scientifico e Tecnologico del Molise "Moliseinnovazione" S.c.p.A. Campobasso, Italy

²Dipartimento di Scienze Animali, Vegetali e dell'Ambiente. Università del Molise, Campobasso, Italy

³Consorzio per la Sperimentazione, Divulgazione e l'Applicazione di Biotecnologie Innovative. Benevento, Italy

Corresponding author: Prof. Fabio Pilla. Dipartimento SAVA. Facoltà di Agraria, Università del Molise. Via De Sanctis, 86100 Campobasso, Italy - Tel. +39 0874 404751 - Fax: + 39 0874 404855 - Email: pilla@unimol.it

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ABSTRACT

Casertana is an Italian autochthonous pig breed. In the past, the breed was common in Campania and the surrounding area in South Italy because it was valued for its productive performance, particularly regarding the fattening tendency, but in recent decades, autochthonous swine have been replaced by cosmopolitan lean-type pigs and the Casertana breed also experienced a dramatic reduction in numbers. Concern over the preservation of genetic resources and the increased demand for regional food suggest a new way of maintaining the breed. Unfortunately, few recent data on the morphological as well as on the productive traits are available. To ascertain the characteristics of the Casertana breed a productive trial was performed by comparing Casertana and Large White pure breed and their cross. Sixteen females and 6 males of pure breed Casertana and 18 females and 2 males of pure breed Italian Large White were mated twice to produce Casertana, Large White and Casertana x Large White piglets. The average number of piglets born was significantly lower in Casertana gilts, but no difference in the number of weaned piglets among genetic types was observed. Sixty-eight animals of the three genetic types were reared outdoors and received two distinct diets differing in energy content. Pigs were weighted individually every month to calculate average daily gain. Morphological traits of Casertana pigs were also recorded. A total of 54 animals (21 Casertana at 151 kg live weight, 15 crossbreed at 157 kg live weight and 18 Large White at 179 kg live weight) were slaughtered and data on carcasses were collected. Average daily weight gain differed markedly ($P < 0.05$) among genetic types (450; 552; 695 g/d, respectively for Casertana; Casertana x Large White; Large White) and consequently the slaughter weight also differed. Casertana showed higher dressing percentages than the Italian Large White ($P < 0.05$). Backfat thickness was also clearly affected by genetic type ($P < 0.05$): Casertana pigs had the highest value (44.91 mm). The diet had no influence on the average daily weight gain and backfat thickness. However, pigs fed with higher energy component had higher ($P < 0.05$) dressing percentage.

Key words: Pig, Pig biodiversity, Casertana breed, Reproductive performances, Productive performances.

RIASSUNTO

CARATTERISTICHE MORFOLOGICHE, PERFORMANCE RIPRODUTTIVE E PRODUTTIVE DI SUINI CASERTANI ALLEVATI ALL'APERTO

La Casertana è un tipo genetico autoctono di suino italiano. Nel passato il suino Casertano veniva comunemente allevato in Campania e nelle regioni vicine ed era apprezzato per le sue prestazioni produttive ed in particolare per la sua tendenza ad accumulare grasso. Nelle ultime decadi però questi suini sono stati sostituiti con animali di razze cosmopolite selezionate per produrre carni più magre ed il loro numero ha subito una drastica riduzione. La recente attenzione alla conservazione delle risorse genetiche e l'aumentata domanda di prodotti tipici hanno reso possibile un rinnovato impie-

go produttivo di questo tipo genetico. Purtroppo pochi dati recenti sono disponibili sulla morfologia e sulla attitudine produttiva della Casertana. Per colmare questa lacuna è stata condotta una prova sperimentale che ha avuto lo scopo di studiare le performance riproduttive e produttive della razza Casertana confrontandole con quelle della Large White e dell'ibrido ottenuto incrociando le due razze. A tal proposito sono stati utilizzati 16 femmine e 6 maschi Casertani e 18 femmine e 2 maschi Large White. Relativamente agli aspetti riproduttivi, la Large White ha mostrato una prolificità superiore ma la Casertana ha rivelato una migliore attitudine materna. Su 68 animali dei tre tipi genetici, allevati all'aperto ed alimentati con due diverse diete, differenti in contenuto energetico, è stato calcolato l'incremento medio giornaliero fino alla macellazione. Su un gruppo di suini Casertani sono stati rilevati i parametri morfologici e i dati ottenuti sono stati confrontati con quelli esistenti in letteratura. Alla macellazione, che ha riguardato 54 animali (21 Casertani di 151 kg, 15 ibridi di 157 kg e 18 Large White di 179 kg), sono stati rilevati, oltre al peso vivo, la resa e lo spessore del grasso dorsale. L'incremento medio giornaliero è stato molto differente ($P < 0,05$) tra i tipi genetici (450; 552; 695 g/d, rispettivamente per Casertana; Casertana x Large White; Large White) e conseguentemente il peso alla macellazione. I suini Casertani hanno avuto una resa alla macellazione più elevata di quella dei suini Large White ($P < 0,05$). Lo spessore del lardo è stato molto diverso ($P < 0,05$) tra i tipi genetici studiati: i suini Casertani hanno mostrato il maggiore spessore (44,91 mm). La dieta non ha influenzato significativamente l'incremento medio giornaliero e lo spessore del lardo dorsale, comunque i maiali alimentati con il livello energetico più elevato hanno avuto la resa al macello più elevata ($P < 0,05$).

Parole chiave: Suini, Biodiversità suina, Razza Casertana, Performance riproduttive, Performance produttive.

Introduction

In past decades, many autochthonous pigs were raised in Italy, among them the Casertana breed. The Casertana pig is medium-small sized, the coat is bright black and mostly hairless (pelatella), the standard type exhibits wattles. The original zone of breeding is the Caserta district but, under other local names, Casertana-type swine were also present in the surrounding areas (Baldassarre, 1899). In the past, the Casertana breed was highly valued mainly because of the high fat deposit as well as its productive performance, but the widespread introduction of cosmopolite breeds in Italy has dramatically reduced the number of Casertana pigs which were not suited to the intensive, quantity-oriented and lean-type pig production system. Today, the breed consists of 88 heads belonging to 6 farms recorded in the Herdbook (ANAS, 2005). The low number of living animals means the Casertana is classified by the FAO as a critical breed.

The Casertana pig could be exploited to obtain niche products linked to the gastronomic traditions of southern Italy (Barone *et al.*, 2003; Gigante *et al.*, 2004). Moreover, extreme phenotypes such as the Casertana can be used to emphasize the loci involved in the productive traits by crossing with selected pigs (Varona *et al.*, 2002) or as a model to understand the physiological process of fat deposition (Andersson, 2001).

Knowledge about the genetic, morphological

and productive characteristics of the breed as well as about its products is essential in order to set up a rational production system. Unfortunately, due to lack of interest in this breed in the past, few recent data on the breed traits and performances are available (Matassino *et al.*, 2000), with the exception of papers regarding meat characteristics (Matassino *et al.*, 1991; Colatruglio *et al.*, 1994; Zullo *et al.*, 2003). In addition, the old data may refer to a population that does not exist anymore due to the dramatic decrease in the number of living animals.

The purpose of this study was not only to increase knowledge regarding the Casertana breed, but also to describe its morphological traits as well as its reproductive and productive performances. A further aim was to compare the productive performance of the Casertana breed to Italian Large White and cross of Casertana x Italian Large White, raised in an outdoor farming system and fed two different diet energy levels.

Material and methods

Animals, housing and sows husbandry

This study involved 20 Italian Large White, 18 gilts and 2 boars, purchased from a commercial farm, and 16 gilts and 6 boars of the Casertana breed obtained from ConSDABI (Consortium for Experimentation, Dissemination and Application of Innovative Biotechniques), Benevento, Italy.

Animals were mated according to genetic type to produce: Casertana and Italian Large White pure pigs and crosses of Casertana boars with Italian Large White gilts. The same animals were mated again to produce: Casertana pure breed and crosses of Casertana boars with Italian Large White sows.

Sows were housed in fender huts. Each hut had a covered surface of 12 square meters and a height of 2 m, the front side was completely open to an outdoor paddock of 40 square meters (Simoni, 2002). The hut floor was covered with straw. Each female farrowed in a single hut without any farrowing fence. The total number of piglets born alive and weaned (at 40 days of age) was recorded.

Growing- finishing period

Sixty-eight weaned animals, randomly selected from the first parity born piglets, were employed for a growing and finishing trial. Thirty-two (14 males and 18 females) Casertana pigs, 18 (10 males and 8 females) Large White pigs and 18 (7 males and 11 females) Casertana x Large White pigs were reared according to genetic type, sex and litter. Pigs were divided into genotype groups of seven to ten individuals and housed in a single hut. Males were castrated after weaning.

The growing trial began at an average age of 92.68 ± 2.27 days and live weight of 35.64 ± 1.81 kg. During the trial, pigs were fed two diets differing in caloric content (HE = high energy and LE =

low energy) according to live weight (from 35 to 60 kg; from 60 to 100 kg; from 100 kg until slaughter). The HE diet was computed according to standard requirements, while the LE diet contained on average energy level 10–20% less than standard requirements. Diets were supplied on a basis of 9% of metabolic weight. Each group was fed twice daily. The chemical composition of the diets (Table 1) was determined in accordance with the official methods of ASPA (Martillotti *et al.*, 1987). During the experimental period, animals had free access to water.

Morphological measurements

Casertana morphological traits at 9 (42 males and 39 females were born from the second litter) and 13 months of age (15 females were born from the first litter) were recorded. Pigs were individually monitored for: height at withers, chest height, chest width, chest girth, width of hips, trunk length and live weight.

Productive performance

Monthly, animals were individually weighted to calculate average daily weight gain (ADG). Weight gains were divided into 3 periods according to each feeding phase: growing phase (35 to 60 kg live weight), fattening phase (60 to 100 kg live weight) and finishing phase (100 to final kg live weight). Before weighing, feed was withdrawn overnight.

On the day of slaughtering, 54 pigs (21

Table 1. Chemical composition of diets (as fed basis).

Diet ¹		Period					
		35 - 60 kg		60 - 100 kg		100 kg- slaughter	
		HE	LE	HE	LE	HE	LE
Dry Matter	%	87.54	86.15	87.08	86.29	86.90	86.56
Crude protein	"	16.34	15.39	16.04	15.82	13.98	13.02
Ether extract	"	5.44	4.34	4.41	3.22	3.30	3.45
Crude fibre	"	3.79	5.30	4.63	7.35	3.87	8.48
Ash	"	4.84	6.71	5.74	6.55	5.78	6.84
NE ²	MJ/kg DM	9.95	8.91	9.25	8.10	9.28	7.53

¹HE = High energy; LE = Low energy.

²Net Energy.

Casertana, 15 crossbreed, and 18 Large White) were transported to a commercial slaughterhouse, located 32 km from the experimental farm, where they were kept for a minimum of 12 hours prior to slaughtering. In accordance with ASPA (1991) recommendation, the following data were collected on each pig: live weight, hot carcass weight and back-fat thickness.

Statistical analysis

Reproductive performances (number of piglets born alive and number of weaned piglets) were processed by ANOVA using a general linear model (SPSS, 2000), with one factor (genetic type x parity), according to the following model:

$$y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

μ = overall mean;

α_i = genetic type x parity effect ($i = 1, \dots, 5$);

ε_{ij} = casual effect.

The same procedure was applied to process data *in vivo* and *post mortem*; analyses were carried out according to the model:

$$y_{ijk} = \mu + \alpha_i + \beta_j + \gamma_k + \varepsilon_{ijk}$$

μ = overall mean;

α_i = genetic type effect ($i = 1, \dots, 3$);

β = diet effect ($j = 1, 2$);

γ = sex ($k = 1, 2$);

ε_{ijk} = casual effect.

The interaction between genetic type, diet and sex was excluded because it was not significant. T Student's test was used to determine significant differences among the mean values.

Results and discussion

Reproductive performances and maternal aptitude

Data concerning reproductive performances, according to genetic type and parity, are shown in table 2. As expected, the Large White performed better than the Casertana breed ($P < 0.05$), since they have also been intensively selected for prolificacy, and crossbreed pigs showed intermediate values that differed only in comparison to the Casertana pigs ($P < 0.05$). However, it is worth not-

ing that the Casertana increased the number of piglets (+2.6) born in the second parity in relation to the first parity ($P < 0.05$).

Since the animals were reared outdoors without employing any farrowing grate, the number of piglets lost due to crushing by the sows was far higher than the loss normally observed when sows are confined. However, despite the fact that the sows delivered during the months of November and December, when the average temperatures recorded were respectively 7.82 and 1.44 °C, no loss of piglets was observed due to the direct effect of climate, and the Casertana piglets showed a remarkable ability to survive extremely low temperatures (-9 °C), even during the first days of life.

When the number of weaned piglets is considered, no significant difference was observed among genetic types, suggesting that the Casertana retains a higher maternal aptitude. On the contrary, the number of weaned piglets was significantly affected by the parity. As expected, the number of weaned piglets of both Casertana breed and crossbreed was higher (+ 3.3) in the second parity ($P < 0.05$). Nevertheless, the effect of the parity is well-know. In this case its effect was not clear due to the seasonal influence since the first parity was in autumn and the latter in spring.

Live traits

In table 3, morphological traits regarding Casertana pigs are reported. The Casertana pig can actually be considered a small-sized breed. Literature on morphological traits of this breed is very scarce and the records available are not fully comparable with our data since they refer to animals reared in very different conditions than those involved in this study. Nevertheless, an increase in size as well as in weight in the current population is evident, when compared to the size and weight of the population in the 1950s (Salerno, 1955; Matassino *et al.*, 2000).

Productive and slaughtering performances

Sex (data not shown) affected only dressing percentage. *In vivo* and slaughter traits are shown in table 4. As expected, the Casertana breed reached a commercial slaughtering weight (about 150 kg) at a considerably greater age than cross-

Table 2. Reproductive performances.

Genetic type ¹	Parity ²	Sows	Piglets born alive	Piglets at weaning
		n.	$\bar{x} \pm SD$	$\bar{x} \pm SD$
CE	I	16	7.75 ^a \pm 0.6	5.37 ^a \pm 0.5
CE x LW	I	9	9.78 ^b \pm 0.8	5.55 ^a \pm 0.7
LW	I	9	10.78 ^b \pm 0.8	4.55 ^a \pm 0.7
CE	II	11	10.36 ^b \pm 0.7	8.82 ^b \pm 0.6
CE x LW	II	13	10.38 ^b \pm 0.7	8.62 ^b \pm 0.6

¹CE = Casertana breed; CE x LW = Crossbreed; LW = Large White breed.

²I = Piglets born in November - December 2001; II = Piglets born in April - May 2002.

^{a,b} on the same column = $P < 0.05$.

Table 3. Morphological traits of Casertana population.

		Males (n. 42)		Females < year (n. 39)		Females > year (n. 15)	
		$\bar{x} \pm SD$	CV%	$\bar{x} \pm SD$	CV%	$\bar{x} \pm SD$	CV %
Age	d	273.10 \pm 14.15	5.18	238.00 \pm 17.19	7.22	374.47 \pm 23.76	6.35
Height at withers	cm	58.02 \pm 3.33	5.74	56.55 \pm 2.93	5.18	65.61 \pm 3.71	5.65
Chest height	"	35.58 \pm 2.04	5.74	33.05 \pm 1.92	5.81	41.81 \pm 1.99	4.75
Chest width	"	26.78 \pm 1.65	6.17	24.95 \pm 1.73	6.93	31.40 \pm 1.36	4.32
Chest girth	"	107.11 \pm 6.61	6.17	99.81 \pm 6.91	6.93	125.61 \pm 5.42	4.32
Width of tips	"	31.64 \pm 1.89	5.98	29.28 \pm 2.07	7.07	35.17 \pm 1.66	4.71
Trunk length	"	81.97 \pm 4.28	5.23	79.03 \pm 4.97	6.29	93.37 \pm 5.48	5.87
Live weight	kg	97.90 \pm 13.15	13.44	80.07 \pm 13.40	16.74	142.97 \pm 13.89	9.71

breed and Italian Large White pigs. On the other hand, Casertana pigs had the lowest total ADG ($P < 0.05$). The highest ADG was obtained from Italian Large White pig and intermediate value from crossbreed ($P < 0.05$). The same ADG trend was observed in the three periods of growth, with Casertana < crossbreed < Large White ($P < 0.05$), but Casertana had a more constant ADG than other pigs from 35 to 100 kg live weight and a rapid decrease of ADG after the fattening phase (>100 kg live weight). The growth curves are reported in figure 1. The ADG gap (-30%) observed in this study between the local and improved breed is analogous to the differences found between the Cinta Senese and the Large White pig (Acciaioli *et al.*, 2002; Franci *et al.*, 2003). No diet differences were found for ADG, except for growing phase (35 to 60 kg live weight), in fact pigs fed HE

diet showed a higher ADG ($P < 0.05$). As a consequence of the differences in growth rate and slaughter age among genetic types studied, the slaughter weight in Italian Large White was higher than that of the Casertana breed and crossbreed ($P < 0.05$) pigs. No significant difference in slaughter weight between Casertana and crossbreed pigs was detected. The lower growth rate of the unselected breed confirms the results found in other autochthonous Italian (Acciaioli *et al.*, 2002; Filetti *et al.*, 2003; Franci *et al.*, 2003) and European (Legault *et al.*, 1996; Serra *et al.*, 1998) breeds. Casertana showed higher ($P < 0.05$) dressing percentage than that shown by Italian Large White and crossbreed pigs. It is known that dressing percentage is positively influenced by fatness also in the rustic pig breeds (Serra *et al.*, 1998; Labroue *et al.*, 2000).

Table 4. Age, average daily gain, live weight at slaughter, dressing percentage and backfat thickness of the animals

		Genetic Type ¹			Diet ²		SEM
		CE	CE x LW	LW	HE	LE	
Age	d	367 ^a	311 ^b	297 ^c	322	333	4.34
ADG (35-60 kg LW ³ .)	g/d	467 ^a	629 ^b	776 ^c	691 ^a	518 ^b	0.021
ADG (60-100 kg LW)	"	491 ^a	568 ^b	685 ^c	604	532	0.015
ADG (100 kg-slaughter LW)	"	361 ^a	488 ^b	648 ^c	503	446	0.016
ADG (trial)	"	450 ^a	552 ^b	695 ^c	571	512	0.018
Slaughter weight	kg	151.0 ^a	157.5 ^a	179.3 ^b	166.8	158.3	2.34
Dressing percentage	%	81.4 ^a	81.0 ^{ab}	79.8 ^b	81.3 ^a	80.4 ^b	0.23
Backfat thickness	mm	44.91 ^a	33.20 ^b	20.33 ^c	33.92	30.20	1.68

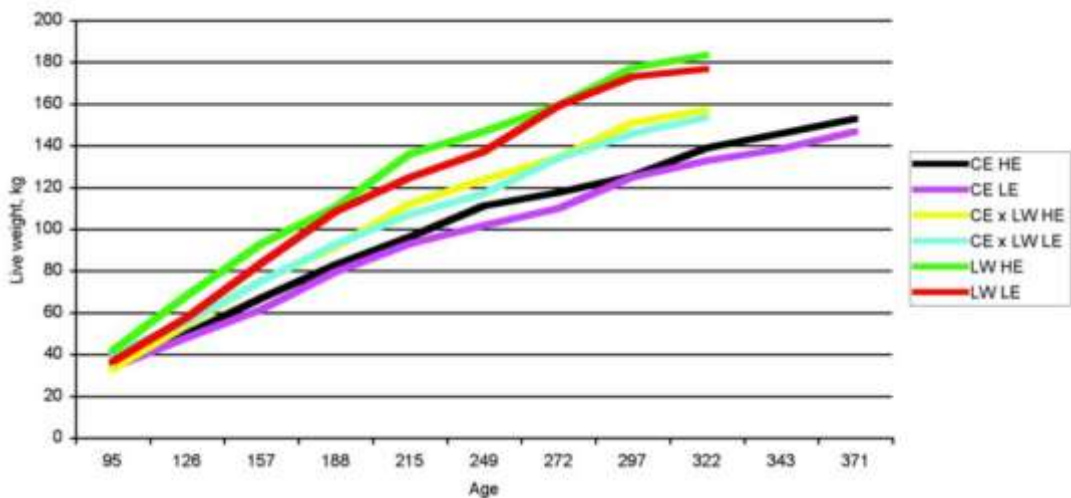
¹CE = Casertana breed; CE x LW = Crossbreed; LW = Large White breed;

²HE = High energy; LE = Low energy;

³ LW: live weight;

^{a,b,c} on the same line = $P < 0.05$.

Figure 1. Evolution of live weight of Casertana, Casertana x Large White and Large White pigs.



CE = Casertana breed; CE x LW = Crossbreed; LW = Large White breed.

HE = High energy; LE = Low energy.

As expected, Casertana were fatter than Large White pigs (with crosses at an intermediate position) for backfat thickness ($P < 0.05$). Particularly, Casertana produced more than double the thickness of the Large White. Similar measurements were found by Fortina *et al.* (2005) on Casertana pigs slaughtered at 200 kg live weight (494 days of age) and fed differently. This substantiates the

aptitude for strong fat deposition of the autochthonous breeds (Labroue *et al.*, 2000), in agreement with the results reported by Acciaioli *et al.* (2002) and Franci *et al.* (2003) on Cinta Senese. There were no significant differences in final weight and backfat thickness due to diet. However, pigs fed HE diet had higher dressing percentage ($P < 0.05$).

Conclusions

In recent years, the Casertana breed had been virtually abandoned, consequently very few scientific papers regarding the breed have been produced over the last decades. In this work, new data describing the morphological traits and the reproductive and productive performance are reported. The Casertana performance was compared to that of a modern cosmopolitan pig breed such as the Large White. The morphological records compared to the data reported in literature confirm the small-medium size of the breed. This finding could also suggest the absence of crossbreeding in the current population with a cosmopolitan big-sized breed.

Comparison with Large White's performance showed that the Casertana is far less competitive than the modern breeds regarding growth performance. Indeed, the commercial slaughter weight was reached 3 months later. As regards the slaughter, the Casertana hot dressing yield was better than the Large White's, even if the backfat thickness was more than double. This considerable difference is likely to be due to the fact that the Casertana breed had never been selected using modern instruments and with the modern goals of fast growth rate and lean meat production.

The productive aptitude of the Casertana suggests that the breed could be competitive with cosmopolitan breeds if the greater backfat thickness can be exploited as a typical product. Of course, more conclusive information on the possible exploitation of the Casertana breed reared outdoor can be drawn when data on carcass and meat quality become available (investigations are currently under way on the carcass composition and fat acid profile).

The semi-extensive farming system adopted in the trial did not impede the growth rate performance and the Casertana breed was particularly successful under this system. Despite the fact that the Casertana gilts were significantly less prolific than the Large White and crossbreed, the same difference was not observed when the number of weaned piglets was considered.

The growth trait intermediate values evidenced by crossbreed pigs confirm the existence of an additive genetic effect. However, the type of

crossbreed obtained does not contribute to the breed conservation strategy.

There were no significant differences in average daily gain and backfat thickness due to diet. However, pigs fed HE had higher dressing percentage

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