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## Grazing behaviour of Cinta senese and its crossbreed pigs

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### ABSTRACT

This study aimed to compare the grazing behaviour of two pig genetic types, Cinta Senese (CS) and its crossbreed with Large White (LW x CS), farmed in natural rearing system in Tuscany, as influenced by diurnal time slot and by the season of the year. *In situ* direct observations on two herds of grazing pigs were conducted during daylight hours for five consecutive days and repeated bimonthly for a period of one year. The observations were grouped into three diurnal time slots and the relative frequencies of the main activities were obtained. Data were subjected to ANOVA with genetic type, diurnal time slot and month as fixed effects. The results, valid for the genotypes and the specific rearing system considered, highlighted that pigs displayed species-specific foraging behaviours for a long time and showed very low levels of other behaviours as aggressive or stereotypes. Both genotypes spent about 72% of the daylight hours for feeding, mainly dedicated to grass feeding. Nevertheless, CS pigs devoted less time to grazing pasture respect to LWxCS. Throughout the months, grazing was preferred to rooting, especially when herbaceous resources were more available. The proportion of diurnal time dedicated to feeding by pigs was reduced with the hot season, but CS seems more affected compared to LWxCS.

### HIGHLIGHTS

- In extensive rearing systems, Cinta Senese pig and its crossbreeds employed most of the diurnal time in grass feeding.
- Cinta Senese pigs devoted less time to grazing pasture respect to LWxCS, especially during hot months and the central hours of the day.

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Local breed; pig; behaviour; feeding; pasture

## Introduction

Cinta Senese is an autochthonous pig breed linked with the agro-forestry area of Tuscany (Italy) since the Middle Ages. At present, the breed represents one of the more interesting examples of succeeded safeguard operation of germplasm and it is a witness of the link among rustic breed, territory and typical products. As well as for other Southern European countries, the practice of crossbreed between local and selected breeds to exploit additive and non-additive genetic effects is diffused in Italy. Usually, Cinta Senese crosses with Large White were used in order to improve both its *in vita* performance and carcass traits (Franci et al. 2003); a description of the two genotypes (phenotype, growth rate, age of slaughter) are reported in Acciaioli et al. (2002) and in Franci (2004). The rearing system of these genotypes is usually outdoors on agricultural land and/or in forest with different levels of

extensivisation and stocking rate. The effect of natural resources on the product of Cinta Senese has been also the topic of a study aimed to the assessment of fatty acid composition of fresh and seasoned products (Pugliese et al. 2013). The outdoor pig farming based on the use of grazing system can produce risks for the ecosystem with a negative impact on environment since pigs, given their ethology, can alter the soil, damage the vegetal component and affect the hydro geological function especially if connected to a high animal density (Grifoni and Gonnelli 2009). In this context, being able to understand the behaviour and the feeding strategies of pigs is crucial for a sustainable and efficient use of natural resources (Rodríguez-Estévez et al. 2009).

Pigs, opportunistic omnivorous, have retained high capacity of adaptation to various dietary resources and have maintained both foraging interest and explorative feeding behaviour based on grazing and rooting. In a

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recent review, Olczak et al. (2015) describe different aspects of pig behaviour and underline that most of the studies are conducted in an indoor system where the environmental factors do not affect the animals. However, there is a lack of studies about the foraging behaviour of local breeds rearing in native extensive agro-system.

This study aimed to compare the grazing behaviour of two pig genetic types, Cinta Senese (CS) and its crosses with Large White (LWxCS) farmed in natural rearing system in Tuscany, as influenced by diurnal time slot and season of the year.

## Material and methods

The study site is Montagnola Senese, considered the original area of the breed (Franci, 2004) located in a hilly area of the Siena province, in the central Tuscany (Italy) (about 43° 17' 30" N; 11° 10' 00" E). The area has cold winters, water deficit in summer and the highest rainfall recorded in autumn and spring. The territory is characterised by natural pastures surrounded by forests formed of stand oak (*Quercus ilex* L.), chestnut (*Castanea sativa* Mill.) and maple (*Acer campestre* L.). This study was carried out in an extensive rearing area with natural pasture and woods limited by fences and provided with shelters. During the day, animals had free access to pasture (about 40 ha) and during the night were enclosed in a paddock of ca. 1 ha. Pigs had free access to water both inside the fence and on pasture, where puddles and small temporal streams were also available. During the night, pigs were usually kept in a fence, whose gate was opened in the morning for free access to the grazing areas.

The trial was conducted according to article 2(f) of Italian legislative decree No 26 of 4 March 2014 implementing Directive 2010/63/EC for the protection of animals used for scientific purposes.

The herd was composed of a variable number of fattening pigs (castrated males and females) weighing from 70 to 140 kg and no nose-ringed. Composition of herd varied during the 11 months of observation period, due to the entry of new young pigs and the exit of individuals ready for slaughter, but the two genotypes, CS and LWxCS, were always adequately represented, normally in the ratio 1:2 with an upper limit of 20 CS and 40 LWxCS. Both genotypes received the same quantity of a concentrate mixture (corn, barley, oats and sunflowers meal) in the morning, as supplementation of pasture resources, at a rate of 0.500 kg/d per animal, as annual average during the whole experimental period.

**Table 1.** Main and detailed behaviours observed.

Main activity	Detailed activity
Feeding	On grass: grass feeding Rooting: rooting with the snout or the hoof
Dynamic activities	Moving: walk, run or other movements
Other activities	Resting: stand, sit, lie or rest Other activities: drinking, bath, excreting or urinating, voice calls, rubbing Stereotypes and aggressive behaviour: bite, nibble, tail bite and stereotypes
Social interaction	In group: engaging with at least another group member Solitary: alone during feeding, moving, resting or other activities

Observation of pig behaviour was carried out by a team of two observers, previously trained to operate under field condition, without interfering with the spontaneous activities of animals. A procedure of familiarisation was used in order to accustom the animals to the presence of the observer, every time a new animal was introduced in the fence. Animals were considered fully familiarised when observers could remain closer than about 5 m from them without affecting or modifying their activity.

*In situ* direct observations were conducted using scan sampling technique (Altmann 1974) on pigs' groups recording the number of visible pigs (on average 14 pigs, minimum 4 and maximum 60) engaged in each activity at predetermined time intervals of 20 minutes. Pigs are distinguished based on the typical colour. Observations were carried out during daylight hours, based on seasonal photoperiod, between 7:00 am and 8:00 pm, bimonthly throughout one year, particularly during the last 10 days of January, March, May, July, September and November. Each observation period was repeated for five consecutive days by both observers who alternated among the genotypes groups during the days. The different types of observation were grouped into main and specific activities (Table 1).

Data were expressed as a percentage of total visible individuals (per genotype) acting the specific activity at that moment. The percentage of pigs dedicated to each activity is expressed as relative amount of time spent performing each specific behaviour, according with Altmann (1974) and Martelli et al. (2014). The results of three consecutive sessions (every 20 minutes) have been pooled to give the relative frequency per hour of each activity, representing thus the experimental unit. Frequencies of the recorded behaviours were subjected to GLM procedure of SAS (SAS 2013) with genotype (CS and LWxCS), diurnal time slot (three daylight time slots; morning, midday and afternoon), month as main fixed effects.

**Table 2.** Effect of genotype, diurnal time slot and month on the pig's behaviour (expressed as percentage of total observed behaviours).

	Feeding			Dynamic activities		Other activities	Social interactions into group
	Feeding	On grass	Rooting	Moving	Resting		
Genotype (G)							
CS	69.5	56.9 <sup>b</sup>	12.5	10.5	19.0	1.1	66.5
LWxCS	74.0	66.1 <sup>a</sup>	7.9	6.5	16.6	2.9	69.7
Diurnal Time Slot (TS)							
Morning	61.3 <sup>c</sup>	55.3 <sup>b</sup>	6.0	8.1	28.0 <sup>a</sup>	2.6	78.4 <sup>a</sup>
Midday	71.1 <sup>b</sup>	58.2 <sup>b</sup>	12.8	7.0	20.1 <sup>a</sup>	1.8	63.6 <sup>b</sup>
Afternoon	82.9 <sup>a</sup>	71.1 <sup>a</sup>	11.8	10.3	5.3 <sup>b</sup>	1.4	62.3 <sup>b</sup>
Month (M)							
January	77.9 <sup>b</sup>	68.7 <sup>b</sup>	9.2 <sup>b</sup>	18.2 <sup>a</sup>	2.3 <sup>c</sup>	1.5 <sup>b</sup>	86.4 <sup>a</sup>
March	92.2 <sup>a</sup>	92.2 <sup>a</sup>	0.0 <sup>c</sup>	7.8 <sup>b</sup>	0.0 <sup>c</sup>	1.2 <sup>b</sup>	51.6 <sup>c</sup>
May	53.9 <sup>c</sup>	14.0 <sup>d</sup>	39.9 <sup>a</sup>	5.1 <sup>b</sup>	40.1 <sup>a</sup>	0.9 <sup>b</sup>	72.0 <sup>b</sup>
July	48.1 <sup>c</sup>	48.1 <sup>c</sup>	0.0 <sup>c</sup>	6.3 <sup>b</sup>	44.2 <sup>a</sup>	1.4 <sup>b</sup>	48.8 <sup>c</sup>
September	86.0 <sup>ab</sup>	86.0 <sup>a</sup>	0.0 <sup>c</sup>	2.5 <sup>b</sup>	6.9 <sup>c</sup>	4.6 <sup>a</sup>	71.1 <sup>ab</sup>
November	72.3 <sup>b</sup>	56.7 <sup>bc</sup>	15.6 <sup>b</sup>	11.0 <sup>ab</sup>	14.5 <sup>b</sup>	2.2 <sup>ab</sup>	78.9 <sup>ab</sup>
RSD	2.9	2.9	2.5	1.8	2.5	6.2	2.6
p-value							
G	ns	*	ns	ns	ns	ns	ns
TS	**	**	ns	ns	**	ns	**
M	**	**	**	**	**	ns	**
GxTS	*	ns	**	ns	**	ns	ns
GxM	*	*	ns	ns	**	ns	**

CS: Cinta Senese; G: genotype; GxM: genotype x month; GxTS: genotype x diurnal time slot; LW x CS: Large White x Cinta Senese; M: month; RSD: residual standard deviation; Significance: \*:  $p < .05$ ; \*\*:  $p < .01$ ; ns: not significant; TS: diurnal time slot. Within criterion, means within factor with different letters are significantly different.

In order to consider the different lengths of the day, the period between 11 a.m. and 14 p.m. was considered as the central hours of the day. The other day slot represents the times of light before and after the midday.

## Results and discussion

Least square means of behaviour activities as influenced by genotype, diurnal time slot and month are reported in Table 2. Pigs spent about 72% of the observation period in feeding activity, mainly devoting to grass grazing (62%), showing a high level of natural foraging interest and of adaptation to extensive rearing. The long time spent in foraging could be linked to the free access to roughage resources, as justified by Presto et al. (2013), as well as to the large area available that influenced the interest to explore (Andersen and Redbo 1999), but also to a minimum concentrate integration distributed. Nevertheless, Rodríguez-Estévez et al. (2009) observing nose-ringed pigs in dehesa natural pasture reported a shorter time of grazing activity (54% of daylight hours) dedicated to foraging activity and attributed this lower result to a lack of water. Pigs did not devote so much time to rooting (about 10%) spending less time respect to pigs on other analogous research under semi-natural condition (Petersen 1994). On average, pigs were moving for 8.5% and were stationary for 17.8% of the time observed; the most frequent behaviour of

inactivity was always lying. Results showed that only 2% of observed time was devoted to other activities (drinking, bath, excreting or urinating, voice calls and aggressive behaviour). Aggressive behaviour or stereotypes were sporadic (<0.01% of other activities). Furthermore, pigs seemed more prone to stay into group (68% of the time). Nicol et al. (1999) suggested that the aggressive behaviour reduction can be linked to a large group size of pigs, to great availability of resources and free space as well as to the presence of feeding places and lying areas. Accordingly, the coexistence of these conditions in our study could be linked to the elimination of stereotypy and aggressive repertoire, often linked to the dominance hierarchy (Hemsworth and Barnett, 2001). Nevertheless, the literature on social and hierarchical interactions for pigs in semi-natural condition is sporadic and most of knowledge is referred to indoor experiments as related by Morrison et al. (2003).

Genetic type did not show statistical influence in feeding, but showed diverse grass feeding interest: LWxCS devoted more time than CS (66.1 vs 56.9%,  $p < .05$ ). The longer time spent by LWxCS in grass-feeding confirms the observation of Quiniou et al. (1999) who, regarding concentrate feed intake, suggest the modern genotype (lean and conventional) devoted more time to feeding than the slow-growing and fat breeds. Indeed, modern genotype ingested smaller size meals but more frequently. Genetics types did not also differ for dynamic behaviour (moving and

resting) and for the time dedicated to other activities. Moreover, genotypes were not different for the behaviour to remain into groups or solitary.

Regarding diurnal time effect, animals devoted more time to feeding during afternoon respect to midday and morning ( $p < .01$ ); in other words, the feeding interest increased as the day progressed probably due to the feed integration distributed to the animals in the morning. Our result was different from the work on wild boars of Rivero et al (2013) who observed a percentage of grazing time greatest in the morning, a second peak in the afternoon and the lowest values in the midday. The interaction between day slot and genotype (Table 3) suggested that in the middle of the day LWxCS engaged more time to total feeding respect to CS (77.4 vs 64.7%,  $p < .05$ ), while in the morning the purebreed spent significantly more time in rooting activity respect to LWxCS (16.5 vs 0%,  $p < .05$ ). Crossbred animals were more interested to rest respect to CS (35.8% vs 20.1%,  $p < .01$ ) in the morning while devoted less time to rest in the middle of the day (12.9% vs 27.2%,  $p < .05$ ; for LWx CS and CS respectively). Anyway, rest decreased during diurnal time (Table 2): from 28% in the morning to 5.3% in the afternoon ( $p < .01$ ). The tendency of CS to reduce feeding activity and increase the time dedicated to rest in the midday can be due to a greater similarity to wild boars characterised by a minor grazing activity during the central hours of the day and peaks at dawn and dusk (Edwards, 2003). Diurnal time slot (Table 2) affected also the aptitude to stay into groups ( $p < .05$ ) by pigs, they were less solitary in the morning respect to midday and afternoon.

Regarding month effect, in every month grazing on grass was preferred to rooting activity, apart from May. Pigs were more engaged in feeding activity in March (92%) and September (86%), both characterised by higher herbaceous production, an average temperature of 15 °C and a relative humidity from 46% to 70%. Furthermore, in summer (from May to July) when average temperature was of 23.5 °C and a relative humidity from 59 to 77%, feeding on grass showed the lowest values. These results suggest that the interest of pig for grass reflects the trend of the vegetative development with high percentage of time dedicated in the early vegetative season and during the regrowth period and less pig interest to grazing in summer when grass was drier. Moreover, the high temperature and humidity could have a negative influence on feeding activity. Pigs were interested in rooting during May, November and January, without difference between genotypes; while animals did not

**Table 3.** Interaction between genotype and diurnal time slot on the pig's behaviour (expressed as percentage of total observed behaviours).

Behaviour	Morning		Midday		Afternoon	
	CS	LWxCS	CS	LWxCS	CS	LWxCS
Feeding	67.2	55.3	64.7 <sup>b</sup>	77.4 <sup>a</sup>	76.5	89.3
Rooting	16.5 <sup>a</sup>	0.0 <sup>b</sup>	9.1	16.5	12.0	11.7
Resting	20.1 <sup>B</sup>	35.8 <sup>A</sup>	27.2 <sup>a</sup>	12.9 <sup>b</sup>	9.5	1.1

CS: Cinta Senese; LW x CS: Cinta Senese x Large White; within criterion, means within diurnal time slot with different letters are significantly different; Significance: <sup>a,b</sup>:  $p < .05$ ; <sup>A,B</sup>:  $p < .01$ .

dedicate time to rooting in July, September and March. According to Andresen and Redbo (1999) and Olczak et al. (2015) pigs prefer loose and humid soils for rooting, instead rooting is reduced when the soil was hard and dry especially in summer months. Genetic types showed different behaviour during July when CS dedicated less time to total feeding respect to LWxCS (33.4 vs 64.0%,  $p < .05$  – not reported for brevity). According to Olczak et al. (2015) the proportion of diurnal time dedicated to feeding by pigs was reduced with the hot season that corresponds to increases of temperature, but CS seems more affected by the hot months respect to LWx CS. Furthermore, the highest percentage of dark skin on the body of CS pigs could have influenced the capacity to research feed during summer. Month affected also dynamic behaviour: moving was more frequent in cold time (January, November) with respect to the other months. As expected, rest was opposite to moving. Furthermore, genotype x month interaction was significant for resting: CS animals were more inactive in July spending 55.1% of the time standing, sitting or lying respect to 32.2% of the crossbreed ( $p < .05$ ). Month affected also the aptitude to stay in group ( $p < .01$ ) and animals remained more grouped in cold months (January and November) while they were more solitary in March and July. Significant interaction between month and genetic type was recognised: during March and May CS engaged more time into group respect to LWxCS (60.6 and 86.1% vs 42.5 and 57.9%,  $p < .01$  – not tabulated), while in July CS spent more time solitary respect to LWxCS (87.3 vs 10.2%,  $p < .05$  – not tabulated) probably due to their greater propensity to rest.

## Conclusion

In conclusion, most of the pig activities are influenced by month and diurnal time slot, confirming the strong environmental effect on pig behaviour in extensive rearing system. In this condition, pigs had the opportunity to express specific behaviours and food-related

activities such as rooting, while other activities (included aggressive behaviours and stereotypes) were almost absent. Clearly, the high aptitude for foraging and the preference of grass grazing respect to rooting is clear especially during periods when herbage was available. Significant differences between the two genetic groups were highlighted only for the interest in grass-feeding (CS spent less time than LWxCS). However, the pigs lived as one group in the same paddock and their behaviour may have been influenced by the innate hierarchical social behaviour and by the tendency to imitate a leader.

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