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THE FAT TISSUE QUALITY: COMPARISON BETWEEN CINTA SENESE × LARGE WHITE AND MORA ROMAGNOLA × LARGE WHITE PIGS

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ABSTRACT

Eighteen crossbred pigs, Cinta Senese × Large White (CS × LW, n = 10) and Mora Romagnola × Large White (MR × LW, n = 8) were included in the study. These two genotypes are used for the production of Casentino dry-cured ham, a typical product of the province of Arezzo, Italy. The comparison of fat tissue properties between two crossbreeds was made, in view of the fact that crossing CS × LW is well investigated whereas information on the crossing MR × LW is lacking. As regards the results, MR × LW pigs had fatter carcasses with thicker subcutaneous fat than CS × LW (33.0 *vs.* 24.4 mm, $P < 0.05$). MR × LW pigs showed higher fat percentage in loin portion than CS × LW (37.8 *vs.* 24.7, $P < 0.05$). Lean/fat ratio was higher in CS × LW than MR × LW pigs. As for chemical analyses, the fat of the CS × LW had higher percentage of moisture (12.93 *vs.* 7.46) and more SFA and PUFA content (43.0 *vs.* 40.2, $P < 0.05$ and 14.0 *vs.* 12.3%, $P < 0.05$), while MR × LW showed higher percentage of MUFA (47.5 *vs.* 42.9, $P < 0.05$).

Key words: fat quality / Cinta Senese / Mora Romagnola / crossbreeding

1 INTRODUCTION

In Southern Europe local breeds are often crossed with improved modern breeds to exploit additive and non-additive genetic effects and to counterbalance some lower performance of autochthonous breed such as Iberian pig in Spain (Ramirez and Cava, 2007) and Cinta Sense pig in Italy (Franci *et al.*, 2007; Sirtori *et al.*, 2011). The use of the crossbreeding between Cinta Senese and Large White pigs in Tuscany has its origins early in last century and provides the so-called "Bigio" or "Tramacchiato". This type of crossbreed was revitalized in the last decade following the recovery of the Cinta Senese. Recently, some studies on this genotype provided some guidance on the productivity of the cross between Large White and Cinta Senese pigs, making possible a characterization (Franci *et al.*, 2005; Sirtori *et al.*, 2011). Differently, the characteristics of Mora Romagnola, both as purebred or crossed, are less known also because of its limited diffusion, which has hampered the interest of the research. The more recent studies on this breed and on the surveys on the breeding area were published by Fortina *et al.* (2005, 2006) and Zambonelli and Bigi (2006). The official inclusion of Mora Romagnola breed, crossed with an improved breed, in the Technical Specifications of a traditional production as the "Prosciutto del Casentino", determines the need to clarify its behaviour in relation to farming economy and quality of product. Cinta Senese and Mora Romagnola are characterized by a slow growth and by high fat deposition (Sirtori *et al.*, 2011; Fortina *et al.*, 2007). Being that adipose tissue is one of the main factors affecting carcass and products quality, the main aim of this study was to assess qualitative and quantitative differences of the fat tissue between these two different crossbreeds.

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2 MATERIALS AND METHODS

The research was carried out on 18 pigs, 10 pigs were crosses of Cinta Senese × Large White (CS × LW) and 8 were crosses of Mora Romagnola × Large White (MR × LW). The two groups, balanced by sex, were kept in two separate outdoor fences and provided feed mixtures *ad libitum*. The slaughter was carried out when the farmer considered reaching visual maturity point of each crossbreed. A portion of loin (loin from the 2nd to the 5th *lumbar vertebrae*) was cut off the carcass and thickness of subcutaneous fat was measured. In order to calculate the lean/fat ratio, loin portion was dissected into subcutaneous fat, further divided into inner and outer layer, intermuscular fat, *Longissimus lumborum* (LL), *Psoas major* (PM) muscles and other lean. On LL and PM muscles ether extract content was determined (AOAC, 1990); i.e. intramuscular fat content. On subcutaneous fat, separately for outer and inner layer, the colour (CIE Lab) was recorded by Minolta colorimeter, and the following analyses were carried out: moisture (AOAC, 1990); total lipids (Folch *et al.*, 1957); fatty acid composition by gas chromatography. Data were processed by GLM procedure of SAS (2007) using the following models (where B = Breed, G = Gender, L = fat layer, W = slaughter weight): for weight, age at slaughter, and average daily gain (ADG) $Y_{ijk} = \mu + B_i + G_j + \varepsilon_{ijk}$; for adipose tissue measures and chemical analyses on LL and PM muscles $Y_{ijk} = \mu + B_i + G_j + b_i \times (W_{ijk}) + \varepsilon_{ijk}$ for moisture, total lipids and fatty acid composition of backfat $Y_{ijkl} = \mu + B_i + G_j + L_k + b_i \times (W_{ijkl}) + \varepsilon_{ijkl}$. All data of tables 2 and 3 are referred to 168 kg of live weight.

Table 1: *Weight and age at slaughter, average daily gain (ADG) of experimental pigs*

	CS × LW	MR × LW	RSD
Live weight at slaughter (kg)	179.3[a]	155.4[b]	21.6
Live weight range (kg)	138÷218	140÷184	-
ADG (kg)	0.352	0.378	0.06
Age (d)	504[a]	446[b]	14.2

CS – Cinta Senese, MR – Mora Romagnola, LW – Large White, RSD – residual standard deviation; [a, b] – different letters denote significant differences (P < 0.05)

Table 2: *Parameters of fat of excised loin portion*

	CS × LW	MR × LW	RSD
Backfat thickness (mm)	24.24[b]	33.00[a]	4.25
Backfat outer layer thickness (mm)	10.88	10.95	1.60
Backfat inner layer thickness (mm)	13.35[b]	22.05[a]	3.63
Fat (%)	24.75[b]	37.81[a]	5.95
Backfat outer layer (%)	12.19[b]	16.35[a]	2.06
Backfat inner layer (%)	9.01[b]	17.62[a]	3.80
Intermuscular fat (%)	3.54	3.83	1.09
Lean/fat	2.74[a]	1.51[b]	0.60
Ether extract of LL (%)[1]	2.11	2.95	1.36
Ether extract of PM (%)[1]	2.22	1.85	0.52
Minolta colour measurements of backfat			
L*	82.44	82.46	1.36
a*	4.83	4.02	1.06
b*	6.17[a]	4.49[b]	0.77

CS – Cinta Senese, MR – Mora Romagnola, LW – Large White, RSD – residual standard deviation; [a, b] – different letters denote significant differences (P < 0.05); [1] percentage on wet basis

3 RESULTS AND DISCUSSION

As regards i*n vita* performances (Table 1), CS × LW pigs were heavier at slaughter than MR × LW. This data results from different age between the two groups due to differences in the reaching of the visual maturity point. ADG was more reliable information, showing the two crossbreeds had similar growth rate during the trial, confirming the values that have been previously reported by Fortina *et al.* (2006) for Mora Romagnola breed and by Sirtori *et al.* (2011) for CS × LW, both reared outdoor.

The characteristic of MR × LW to deposit more fat (Fortina *et al.*, 2006) was confirmed by the dissection of the loin portion (Table 2). The thickness of subcutaneous fat was higher in MR × LW than in CS × LW, particularly the inner layer. During growth, middle and inner fat layers have a more dynamic development than the outer layer; differences in backfat between pigs are basically related to the different development of the middle and inner layers (Zudaire and Alfonso, 2013). Consequently the lean/fat ratio was higher in CS × LW than in MR × LW pigs. No significant differences were observed between the two crossbreeds in intramuscular fat content of LL and PM. As for instrumental colour, CS × LW showed higher b* value of fat probably due to the highest content of PUFA which are associated with the carotenoids (Maw *et al.*, 2003).

Chemical analyses of backfat (Table 3) showed higher moisture in CS × LW than MR × LW pigs. In regard to fatty acid profile, subcutane-

Table 3: *Fatty acids composition of fresh backfat (%)*

	CS × LW	MR × LW	RSD
Moisture	12.93[a]	7.46[b]	1.51
Totallipids	73.17	75.60	4.10
C16:0	26.18[a]	24.34[b]	0.77
C18:0	15.04	14.37	1.02
C18:1	39.79[b]	44.42[a]	1.84
C18:2	12.83[a]	11.31[b]	1.49
C18:3	0.56[a]	0.26[b]	0.19
SFA	43.06[a]	40.20[b]	1.66
MUFA	42.94[b]	47.50[a]	2.03
PUFA	14.00[a]	12.31[b]	1.70
PUFAn3	0.56[a]	0.26[b]	0.19
PUFAn6	13.44[a]	12.05[b]	1.60

CS – Cinta Senese, MR – Mora Romagnola, LW – Large White, RSD – residual standard deviation; [a, b] – different letters denote significant differences ($P < 0.05$)

ous fat of MR × LW pigs was characterized by higher values of MUFA in particular C18:1. The other groups of fatty acids (SFA and PUFA) were higher in CS × LW mainly due to higher percentage of C16:0 and C18:2, C18:3. These data show, that regardless of the diet, the genetic component has an important role in fatty acid composition of backfat, as previously reported (Wood *et al.*, 2008; Pugliese *et al.*, 2012).

4 CONCLUSIONS

The results showed that MR × LW crossbreed deposited more fat than CS × LW. This trend is evident in the subcutaneous fat. This result indicates that this crossbreed is able to reach an ideal carcass composition faster, with a good quantity of fat at lower weights and ages. The lower fat deposition of Cinta Senese crossbreed reduces the quantity of fat tissue in carcass and this favours a higher lean/fat ratio. This is important from an economic point of view for the "*Prosciutto del Casentino*" production for which a good lean/fat ratio is crucial.

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6 REFERENCES

A.O.A.C. 1990. Official methods of analysis of the Association of Official Analytical Chemist. 15th Edn. Ed. Ass. Off. Analyt. Chemists, Washington

Folch J., Lees M., Stanley G.H.S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. Journal of Biology and Chemistry, 226: 497–509

Fortina R., Barbera S., Lussiana C., Mimosi A., Tassone S., Rossi A., Zanardi E. 2005. Performances and meat quality of two Italian pig breeds fed diets for commercial hybrids. Meat Science, 71: 713–718

Fortina R., Tassone S., Barbera S., Mimosi A. 2006. Prova di alimentazione delle razze Mora Romagnola e Casertana. Performance produttive e qualità della carne. Rivista di Suinicoltura, 47, 7: 103–105

Fortina R., Cornale P., Lussiana C., Mimosi A., Opsi F., Tassone, S. 2007. Diet of Mora Romagnola and Fumati hybrid pigs: trials conducted on purebred and crossbred (Large White × Mora Romagnola). Rivista di Suinicoltura, 48, 12: 101–104

Franci O., Bozzi R., Pugliese C., Acciaioli A., Campodoni G., Pianaccioli L., Gandini G. 2005. Performance of Cinta Senese pigs and their crosses with Large White 1. Muscle and subcutaneous fat characteristics. Meat Science, 69: 545–550

Franci O., Pugliese C., Acciaioli A., Bozzi R., Campodoni G., Sirtori F., Pianaccioli L., Gandini G. 2007. Performance of Cinta Senese pigs and their crosses with Large White. 2 Physical, chemical and technological traits of Tuscan dry-cured ham. Meat Science, 76: 597–603

Maw S.J., Fowler V.R., Hamilton M., Petchey A.M. 2003. Physical characteristics of pig fat and their relation to fatty acid composition. Meat Science, 63: 185–190

Pugliese C., Sirtori F. 2012. Quality of meat and meat products produced from southern European pig breeds. Meat Science, 90: 511–518

Ramirez M.R., Cava R. 2007. Carcass composition and meat quality of three different Iberian × Duroc genotype pigs. Meat Science, 75: 388–396

Sirtori F., Crovetti A., Meo Zilio D., Pugliese C., Acciaioli A., Campodoni G., Bozzi R., Franci O. 2011. Effect of sire breed and rearing system on growth, carcass composition and meat traits of Cinta Senese crossbred pigs. Italian Journal of Animal Science, 10, 4: 188–194

Wood J.D., Enser M., Fisher A.V., Nute G.R., Sheard P.R., Richardson R.I., Hughes S.I., Whittington F.M. 2008. Fat deposition, fatty acid composition and meat quality: A review. Meat Science, 78: 343–358

Zambonelli P., Bigi D. 2006. Mora Romagnola, le attuali esperienze sono positive. Rivista di Suinicoltura, 47, 1: 64–68

Zudaire G., Alfonso L. 2013. Firmness of the Individual Subcutaneous Adipose Tissue Layers of Pig Carcasses and its Relationship with other Fat, Carcass and Meat Quality Criteria. Journal of Animal Production Advances, 3, 1: 12–19