Meat Science 93 (2013) 92–97

Contents lists available at SciVerse ScienceDirect

Meat Science

journal homepage: www.elsevier.com/locate/meatsci

Quality of fresh and seasoned fat of Cinta Senese pigs as affected by fattening with chestnut

C. Pugliese *, F. Sirtori, A. Acciaioli, R. Bozzi, G. Campodoni, O. Franci

Dipartimento di Biotecnologie Agrarie, Sezione di Scienze Animali, Via delle Cascine, 5, 50144 Firenze, Italy

ARTICLE INFO

Article history:
Received 15 February 2012
Received in revised form 13 July 2012
Accepted 4 August 2012

Keywords:
Cinta Senese
Pigs
Chestnut
Meat quality
Fatty acid
Seasoned fat

ABSTRACT

This trial was aimed to verify the effect of fattening with chestnut on carcass characteristics and on quality traits of products of Cinta Senese breed. Thirty-three Cinta Senese pigs were allotted into three groups. One group was fed a commercial feedstuff (0-CH), the other two groups were fed chestnut for one (1-CH) or three (3-CH) months. Pigs were slaughtered at 130 kg of live weight. The 1-CH group showed significantly lower pH value at 24 h ($P<0.05$). For sample joint dissection a significant effect ($P<0.05$) of feeding system was found only on intermuscular fat, highest in 1-CH. A significant effect of feeding system ($P<0.05$) was found on physical and chemical parameters of *Longissimus lumborum*: the 3-CH group showed the highest values ($P<0.05$) of L*, a*, b*, drip loss, cooking loss, shear force and intramuscular fat on raw meat. The 3-CH showed significantly higher level ($P<0.05$) of unsaturation for the highest percentage of MUFA and PUFA.

1. Introduction

Cinta Senese is a local pig breed reared mainly in Tuscany. Among the Italian autochthonous pig breeds, the Cinta Senese has good perspectives of increasing its relevance due to the high number of animals raised and the strong link with the Tuscan territory. Currently the breed is one of the most interesting examples of recovery and preservation of native germplasm preservation (Franci & Pugliese, 2007). Grazing in a forest is used for various extents of time for Cinta Senese pig and this type of rearing allows growers to exploit feed resources that would be otherwise unused.

Recently, the Cinta Senese meat obtained the Protected Designation of Origin (PDO). The rules of the PDO, require that, to obtain the designation, it is necessary to rear animals outdoors, grazing in the forest or in the pasturable land. Consequently it is very important to know the effect of outdoor rearing system on fresh and cured product quality.

The effect of the rearing system on quality of the products of local pigs, has been studied both on physical (Lopez-Bote et al., 2008; Pérez-Palacios et al., 2010; Pugliese et al., 2004, 2005) and chemical traits (Andrés et al., 2001; Cava, Ruiz, Ventanas, & Antequera, 1999a; Cava, Ventanas, Tejeda, Ruiz, & Antequera, 2000; Coutron-Gambotti, Gandemer, & Casabianca, 1998; Diaz, Garcia Regueiro, Casillas, & De Pedro, 1996; Pugliese, Pianaccioli, Sirtori, Acciaioli, & Franci, 2007; Pugliese, Sirtori, D'Adorante, et al., 2009; Pugliese, Sirtori, Ruiz, et al., 2009). Due to the rearing systems of the local pig breeds (almost always outdoors), these studies mainly report the effect on quality of the products of the combined results of both the farming system and the feeding regimen. The latter, for the pigs reared in forest, is often the combination of contemporary ingestion of grass and acorn and/or chestnut. Knowledge of the effect of providing of acorn or chestnut in controlled rearing conditions is very scarce (Coutron-Gambotti et al., 1998; Zumbo et al., 2007). Even more scarce is information on the minimum period of administration of these diets that allows the characteristics of the products to develop.

Nowadays, one of the main problems in the rearing of Cinta Senese pigs is linked to the use of the forest that, in many cases, occurs in an inadequate way. Frequently, the number of animals per hectare is very high and the period of pasture in the forest is longer than the time of effective availability of natural sources, causing irreparable damage to the soil, to the tree and also to the underbrush, which often is completely destroyed (Campodoni, Acciaioli, & Bozzi, 2010). Therefore, it would be very useful to know the minimal period of feeding of wood fruits (chestnut and/or acorn) to obtain a marked difference in the final product.

Cured lard is a typical Italian dry cured product that is now back in vogue as a gourmet product, flanking other well known Italian lards such Arnaud and Colonnata. The lard of Cinta Senese is usually seasoned with a dry-seasoning technique, contrary to Colonnata lard, which is cured in brine. The curing time can vary from 3 to 6 months, it depends on the technique which can vary from one producer to another (Pugliese, Sirtori, D'Adorante, et al., 2009).

The primary aim of this study was to determine the effect of the administration of chestnuts for a variable period during fattening,

* Corresponding author. Tel.: +39 0553288263; fax: +39 055321216.
E-mail address: carolina.pugliese@unifi.it (C. Pugliese).

0309-1740/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.meatsci.2012.08.006

on the chemical and physical characteristics of fresh meat and fat and on the seasoned lard. Other specific objectives were to compare fatty acid composition of subcutaneous fat tissues both of different layers (outer and inner) and during the seasoning period.

2. Materials and methods

2.1. Animals and diets

The trial was carried out indoors to better evaluate the effect of chestnuts during the fattening period in a controlled system, even though the indoor system is not the usual form of rearing of Cinta Senese pigs.

Thirty-three pigs, at an average weight of 97 kg and 289 days old, were employed (Table 1). The final target weight was 130 kg, and the age at slaughter was 378 days, on average; it was greater than 12 months, which is the minimum slaughtering age imposed by the specification of the PDO. During the fattening period (last 3 months before slaughtering), the animals were allotted into three groups, balanced for sex, age and live weight. One group was fed a commercial mixture (0-CH) for the whole fattening period, a second group (1-CH) was fed the same mixture during the first 2 months and chestnut during the last month; a third group (3-CH) was fed chestnut during the all 3 months of the trial. Chestnuts for groups 1 and 3-CH were inclusive of the shell. In addition to the chestnuts 10% of bran was also given to assure the regularity of intestinal functions. Diets were distributed to ensure similar DE intake among the groups, as reported in Table 1 that details the diet characteristics and the pigs' average feed intake. Before the experimental period animals were reared together and fed the same commercial feedstuff.

The chemical analyses of feed were carried out following the methods reported below. At the end of the trial period, animals were slaughtered, in the same public slaughterhouse, on three distinct days within 2 weeks.

2.2. Carcass measures and seasoning process

At slaughtering, the thickness of backfat was recorded at the last thoracic vertebra (LT) and at the *Gluteus medius* (Gm) level. At 45 min (pH_{45}) and 24 h (pH_{24}) post-mortem, pH was measured on *Longissimus lumborum* muscle, near the 10th lumbar vertebra. The day after slaughtering, a sample of the loin (portion of loin from 2nd to 5th lumbar vertebra), inclusive of subcutaneous fat and skin, was removed. The sample of the loin was dissected into lean, fat and bone. The lean portion was separated in *Longissimus lumborum* (LL), *Psoas major* (PM) and "other muscles"; subcutaneous fat was separated in outer and inner layers. Each portion was weighed. The backfat of the lumbar region of the left side was sectioned off in blocks and completely covered by a mixture composed of sea salt and pepper (150 g of pepper/1000 g of sea salt) and kept in a cold room (4 °C and RH of 80%). After 1 month of salting the salt/pepper mixture was removed and the seasoning process continued, under the same environmental conditions, for another 2 months. The seasoning was carried out in a small salami factory where onsite equipment was used. At 0, 30, 60 and 90 days of seasoning the lard was sampled (about 50 g of product), the samples were stored at −80 °C until the analysis.

Table 1
Daily feed intake and nutritive characteristics of the diets.

	Chestnut[a]	Mixture[b]
Feed intake (kg d.m./day/head)	2.7	2.7
Diet composition		
Crude protein (g/kg d.m.)	55.4	189
Digestible energy (kcal/kg d.m.)	3029	2958
Energy/protein (kcal/g)	54.7	15.7
Fatty acids (g/kg d.m.)		
SFA	3.9	2.6
MUFA	9.1	3.0
PUFA — n−3	1.6	0.7
PUFA — n−6	9.2	7.2

[a] 10% of wheat bran was added.
[b] Ingredients (g/kg): maize (330); barley (270); wheat bran (220); soybean meal (150); and supplement (30).

2.3. Chemical and physical analyses

Twenty-four hours after slaughtering, on LL the following physical determinations were carried out:

1) colour measurement (L*, a* and b*) by Minolta Chromameter CR-200: it was taken 24-h post-mortem on the cut surface, after 1 h rest at 4 °C, according to official method (Boccard et al., 1981); the hue angle ($H° = \arctan(b^*/a^*)$) and Chroma ($C^* = ((a^*)^2 + (b^*)^2)^{0.5}$) parameters were also calculated.
2) water-holding capacity (WHC) by the techniques proposed by Grau and Hamm (1952) and modified by Pugliese et al. (2005): drip loss on slices stored horizontally for 48 h; cooking loss after boiling the meat samples in water-bath until the centre temperature reached 75 °C; free water by filter paper press method.
3) shear force by Instron 1011 apparatus on raw and cooked meat: two cylindrical cores (Ø 2.54 cm) parallel with the fibre direction, are sheared by a V-shaped blade with an angle of 60° at a velocity of 100 mm/min (Boccard et al., 1981). The maximal forces for the cylindrical cores are averaged to obtain one value per sample.

On LL and PM muscles the following chemical analyses were carried out according to AOAC methods (1990):

1) moisture by lyophilising to constant weight;
2) intramuscular fat (IMF) as ether extract;
3) protein percentage by Kjldahl method.

Fresh and cured fat samples were analysed for:

1) colour measurements according to the previously mentioned method;
2) total lipid content (Folch, Lees, & Stanley, 1957);
3) fatty acid profile of total lipids. Fatty acid methyl esters were prepared by esterification in the presence of sulphuric acid and were analysed by gas chromatography using a DANI 86.10 apparatus equipped with a flame ionisation detector (FID). Fatty acid separation occurred in a capillary column coated with FFAP-TPA stationary phase (30 m length; 0.32 mm internal diameter; 0.25 μm film thickness). The temperature of the column started at 160 °C and reached 220 °C, increasing 2 °C/min. Temperature of the detector was set at 260 °C. The individual methyl esters were identified by their retention time. Results are expressed as percentage of total fatty acids.
4) free malondialdehyde (MDA) content, determined according to the method of Pikul, Leszczynski, and Kummerow (1983): 2.4 g of tissue was homogenised in 4 ml of BHT 0.01 g/ml chloroform and 15 ml TCA (5%). The homogenate was centrifuged for 15 min at 2000 rpm at 4 °C and 2 ml of the aqueous supernatant was added to 3 ml TBA 0.02 M. When the solution was coloured the pH was adjusted to approximately 7, then the solution was filtered with chromatographic cartridges to obtain the solid phase extraction (Sep-Pak Cartridges, waters Corporation, Massachusetts) and remove extraneous products. Finally a colour reading was made with spectrophotometer (PerkinElmer EZ-150) at a wavelength of 535 nm. MDA content was expressed in mg/kg of total lipids.