ABSTRACT

The aim of this study was to assess the effect of the indoors (IN) vs. outdoors (OUT) rearing system on quality traits of dry cured coppa from Nero Siciliano pig. Physico-chemical parameters, fatty acid profile and α- and γ-tocopherol were investigated. The IN group showed a higher level of fat compared to the OUT group (42.45% vs. 37.85%; P = 0.005). Significant differences were found for salt content (IN: 4.70% vs. OUT: 5.44%; P < 0.0001), Lightness (L*) and yellow index (b*) were higher in the IN than OUT group (L*: 60.24 vs. 56.44, P = 0.023; b*: 6.89 vs. 5.32; P = 0.002). No significant differences were observed for fatty acids profile and for α- and γ-tocopherol. As dry cured coppa from both groups showed a similar quality level, to guarantee the availability of this product all through the year, the indoor rearing system based on commercial feed could replace the traditional outdoor system, when natural resources are limited.

Key words: Nero Siciliano pig/ rearing system/ dry cured coppa/ technological quality/ fatty acid profile

1 INTRODUCTION

Dry cured »coppa« is a traditional Italian product made of deboned muscles of the entire neck, cured and matured in natural casings. As it is known that quality of seasoned products depends, among others, on genetic type and rearing system (Zullo et al., 2007), qualitative traits of dry cured »coppa« from Nero Siciliano pigs fattened indoors and outdoors were investigated. Nero Siciliano pig is an autochthonous genetic type reared in Sicily in the Nebrodi area characterized by high roughness and strength (Pugliese et al., 2004; Zumbo et al., 2012; Di Rosa et al., 2012). Its survival depends on both the possibility of obtaining quality meat products and its adaptation to the harsh environment (Chiofalo et al., 2007). The traditional link between the breed and its typical products may represent an important tool to increase the value of its farming (Moretti et al., 2004) together with new strategies to increase the number of pigs in order to guarantee the availability of dry cured products all through the year. A possible strategy could be an indoor rearing system based on commercial feed to replace the traditional outdoor system when natural resources are limited.

The aim of the present study was to evaluate the effect of the rearing system on physico-chemical characteristics, fatty acid profile and α- and γ-tocopherol of dry cured »coppa« from Nero Siciliano pigs fattened indoors on commercial feed and outdoors on acorn and grass.

2 MATERIAL AND METHODS

This study was carried out on 40 Nero Siciliano pigs (20 males and 20 females). During the fattening period animals were divided into two dietary groups. The indoor group (IN) was reared in confinement and fed commercial feed while the outdoor group (OUT) was raised under the traditional free-range system and fed acorn and grass. At the end of the finishing period (60 days), pigs were slaughtered at a live weight of 117.2 kg (±15.7) and...
104.5 kg (±12.6) for the IN and the OUT group respectively.

Neck muscles were trimmed, subcutaneous fat removed and stored 12 h at a temperature of 0–2 °C. »Coppa« were rolled manually in a tank with salt and additives at a temperature of 3–5 °C. The pieces were tumbled at two day intervals for three times and, six days later, the cuts were salted again and tumbling was repeated a fifth and a sixth time at two day intervals. After 12 days, each piece was hung for 24 hours and then stuffed in natural casings (bovine bladder). Salting was followed by a drying period at 19 °C and 60% RH for the first 8 h with a temperature and relative humidity decreasing every 24 h at a rate of 1.5 °C and 2% respectively. Maturing took place at 13–15 °C and RH of 70–75% for 90 days.

Samples for laboratory analyses were taken from cross-sections of each product avoiding heads and tails for about 5 cm. A portion of about 150 g of each sample were ground using a commercial grinder and the chemical composition (moisture, protein, fat and salt content) was determined according to the Association of Official Analytical Chemists (reference 2007.04) by Near Infrared Transmittance Spectroscopy (FoodScan™ Meat Analyzer; FOSS, Italy). The determination of pH was carried out by homogenization with distilled water (1/10 weight/volume). Colour parameters were measured on two whole slices taken from the middle part of each sample, using a spectrometer (Spectral scanner, DV Tecnologie d’Avanguardia, Padova, Italy). The CIE system colour profile for lightness (L*), red (a*), and yellow index (b*) was applied.

Fatty acid composition was determined on the lean portion of each sample and lipid extraction was performed according to Folch et al. (1957). Fatty acid methyl esters (FAME) from obtained lipids were prepared by trans-esterification according to Christie (1993). FAME were analyzed by gas chromatography, using an Agilent Technologies 6890N gas chromatograph, equipped with a flame ionization detector (FID) and a fused silica capillary column (30 m x 0.25 mm ID, 0.25 μm film thickness, Omegawax 250; Supelco Bellefonte; PA, USA). Individual compounds were identified by comparing their retention times with those of standards (Supelco, Bellefonte; PA, USA). The quantification of α- and γ-tocopherol was accomplished according to Liu et al. (1996) by reverse phase HPLC (Shimadzu LC-10 AT). Tocopherols were quantified using the external standard method.

Data were submitted to analysis of variance by the two-way ANOVA procedure (SAS, 2001) with rearing system and gender as independent variables; no significant differences for sex and interactions were found (P > 0.05) and therefore the model was reduced to main effect only (rearing system). The Scheffé’s test (P ≤ 0.05) was used for the evaluation of significant differences between means.

### 3 RESULTS AND DISCUSSION

Physico-chemical composition of dry cured »coppa« is reported in Table 1. Significant differences were found for fat and salt content. The IN group showed a higher level of fat compared to the OUT group (42.45% vs. 37.85%; P = 0.005) and as consequence, a lower level of salt probably because the fat had a retarding effect on diffusing during seasoning period (Vestergaard et al., 2005). Significant differences were found for L* (P = 0.023) and b* (P = 0.002); higher in the IN group according to the higher fat content (Carballo et al., 1996); in fact, a low-fat product is darker and redder than a high-fat product (Jiménez-Colmenero et al., 2012).

Except for the C16:1 percentage that was higher in the »coppa« of outdoor pigs, no significant differences were observed for fatty acids profile (Table 2) between the IN and OUT group even though dry cured »coppa« from Indoor system showed a slight lower content of PUFA, C18:2 n-6, C18:3 n-3 if compared to Outdoor system.

The α-tocopherol concentration was higher in the OUT group,
while the γ-tocopherol content was lower in the OUT group despite its higher level in acorn (46.33 mg/kg) compared to commercial feed (0.75 mg/kg). According to recent findings (Pugliese et al., 2009; Daza et al., 2005), γ-tocopherol concentration in dry cured “coppa” seems to be related more to γ-tocopherol metabolism than the diet. In fact γ-tocopherol is metabolized largely to 2,7,8-trimethyl-2-(β-carboxyethyl)-6-hydroxychroman (γ-CEHC), which is mainly excreted in the urine. Catabolism of α-tocopherol appears to be quantitatively much less important than that of γ-tocopherol because urinary excretion of α-CEHC is lower than that of γ-CEHC. Both γ-tocopherol and γ-CEHC, but not α-tocopherol, inhibit cyclooxygenase activity and, thus, possess anti-inflammatory properties (Jiang et al., 2001). Therefore, both a faster γ-tocopherol catabolism and a higher stress due to the outdoor system could explain the lower content of γ-tocopherol in dry cured “coppa” from the OUT group.

Nutritional values (Table 1) of dry cured “coppa” from Nero Siciliano pig are very similar to those reported from different authors (Novelli et al., 1992; Schivazappa et al., 1997; Zanardi et al., 2000; La Pietra et al., 1998; Cengarle et al., 2001).

Slight differences can be related to the anatomical structure of “coppa”, i.e. to the presence of various muscles separated by deposits of intermuscular fat (Novelli et al., 1992; Schivazappa et al., 1997), to the different seasoning period and to the technology production. IN and OUT groups showed a lower moisture and salt content if compared with dry cured “coppa” from northern Italy (Zanardi et al., 2000), Campania (La Pietra et al., 1998), Sardegna and Corsica (Cengarle et al., 2001), with a Seasoned Index of 1.22 and 1.20 respectively. Furthermore, both groups showed a higher level of fat probably due to the breed-dependent ability to synthesize and accumulate large amount of lipids in their tissues (Ventanas et al., 2008). In conclusion, even though dry cured “coppa” from Nero Siciliano reared outdoors showed better nutritional traits, both groups are characterized by a physico-chemical profile similar to other Italian dry cured “coppa”.

Based on these preliminary results, it could be argued that, as in Spanish system (Montanera, Recebo, Cebo), when natural resources are limited or not available, Nero Siciliano pigs could be reared indoors on commercial feed to produce a different label product (according to the feeding background), in order to satisfy the commercial demand of dry cured “coppa” all through the year.

### Table 2: Fatty acids and tocopherols content of dry cured “coppa”

<table>
<thead>
<tr>
<th>Fatty acids</th>
<th>IN mean</th>
<th>IN sd</th>
<th>OUT mean</th>
<th>OUT sd</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>C14:0</td>
<td>1.20</td>
<td>0.11</td>
<td>1.15</td>
<td>0.08</td>
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</tr>
<tr>
<td>C16:0</td>
<td>22.63</td>
<td>1.34</td>
<td>22.45</td>
<td>0.67</td>
<td>ns</td>
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<tr>
<td>C16:1</td>
<td>2.39</td>
<td>0.31</td>
<td>2.12</td>
<td>0.18</td>
<td>0.047</td>
</tr>
<tr>
<td>C18:0</td>
<td>12.81</td>
<td>0.44</td>
<td>13.06</td>
<td>0.62</td>
<td>ns</td>
</tr>
<tr>
<td>C18:1</td>
<td>48.98</td>
<td>1.34</td>
<td>48.01</td>
<td>2.05</td>
<td>ns</td>
</tr>
<tr>
<td>C18:2 n-6</td>
<td>9.23</td>
<td>1.47</td>
<td>10.13</td>
<td>1.34</td>
<td>ns</td>
</tr>
<tr>
<td>C18:3 n-3</td>
<td>0.46</td>
<td>0.17</td>
<td>0.52</td>
<td>0.09</td>
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</tr>
<tr>
<td>C20:0</td>
<td>0.20</td>
<td>0.01</td>
<td>0.20</td>
<td>0.01</td>
<td>ns</td>
</tr>
<tr>
<td>C20:1</td>
<td>1.31</td>
<td>0.16</td>
<td>1.42</td>
<td>0.18</td>
<td>ns</td>
</tr>
<tr>
<td>C20:2 n-6</td>
<td>0.53</td>
<td>0.09</td>
<td>0.60</td>
<td>0.07</td>
<td>ns</td>
</tr>
<tr>
<td>C20:4 n-6</td>
<td>0.26</td>
<td>0.10</td>
<td>0.35</td>
<td>0.10</td>
<td>ns</td>
</tr>
<tr>
<td>SFA†</td>
<td>36.85</td>
<td>1.49</td>
<td>36.86</td>
<td>1.13</td>
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</tr>
<tr>
<td>MUFA†</td>
<td>52.68</td>
<td>1.47</td>
<td>51.54</td>
<td>2.29</td>
<td>ns</td>
</tr>
<tr>
<td>PUFA†</td>
<td>10.48</td>
<td>1.75</td>
<td>11.60</td>
<td>1.53</td>
<td>ns</td>
</tr>
<tr>
<td>PUFA/SFA</td>
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<td>0.05</td>
<td>0.31</td>
<td>0.04</td>
<td>ns</td>
</tr>
<tr>
<td>n-6/n-3</td>
<td>23.11</td>
<td>3.92</td>
<td>21.61</td>
<td>2.74</td>
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<tr>
<td>Atherogenic Index</td>
<td>0.44</td>
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<td>0.43</td>
<td>0.02</td>
<td>ns</td>
</tr>
<tr>
<td>Thrombogenic Index</td>
<td>1.12</td>
<td>0.08</td>
<td>1.11</td>
<td>0.05</td>
<td>ns</td>
</tr>
</tbody>
</table>

* Values are means expressed as percentage of total fatty acid methyl esters; † SFA, total amount of saturated fatty acids; ‡ MUFA, total amount of monounsaturated fatty acids; § PUFA, total amount of polyunsaturated fatty acids; †† Expressed as mg kg⁻¹

4 ACKNOWLEDGMENT

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5 REFERENCES


