CSIRO PUBLISHING

Animal Production Science, 2015, **55**, 1037–1043
http://dx.doi.org/10.1071/AN14036

Fatty acids composition, cholesterol and vitamin E contents of *Longissimus dorsi* and *Semitendinosus* muscles of Suino Nero Lucano pigs slaughtered at two different weights

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Abstract. The nutritional quality of the lipid fraction of two muscles (*Longissimus dorsi* and *Semitendinous*) from Italian autochthonous genotype Suino Nero Lucano pigs slaughtered at two different weights was evaluated. Meat of Suino Nero Lucano pig showed a relatively low content of cholesterol and a higher proportion of unsaturated (UFA) than saturated fatty acids (SFA). Total cholesterol content was influenced by muscle, being higher in *Longissimus dorsi* (LD) than in *Semitendinous* (ST) muscle. No significant effects related to slaughter weight or muscle were found regarding vitamin E content. Slaughter weight strongly influenced n-3 and n-6 polyunsaturated fatty acids (PUFA) contents that decreased with increasing weight, and consequently, PUFA/SFA ratio. Muscle markedly influenced the contents of SFA, monounsaturated fatty acids (MUFA), and PUFA, and the dietetic properties of the meat. ST muscle, compared with the LD muscle, showed higher PUFA/SFA and PUFA n-6/PUFA n-3 ratios, and lower atherogenic and thrombogenic indices.

Received 24 January 2014, accepted 28 May 2014, published online 1 October 2014

Introduction

The ancient autochthonous genetic type (AAGT) represents the biological memory of the species evolution, because it is the result of biological modifications that have occurred over hundreds of thousands of years. The importance of these indigenous breeds is linked to the conservation of genetic resources that represents, today, a priority goal to support livestock improvement (Alfonso *et al*. 2005). The breeding of autochthonous pig plays an important social and environmental role in many sensitive areas of Italy, contributing to the conservation of soil, landscape and local flavours. The Suino Nero Lucano (SNL) is an autochthonous pig breed of southern Italy (Basilicata region). It is medium sized with a bright black coat, is characterised by high rusticity and bred in wild or semi-wild conditions. The SNL pig has slower growth rate and greater fatness. On average, the birthweight of piglets is ~1.1 kg, the weaning weight ranges from 8 to 9 kg (55–60 days of age), age at puberty ranges from 240 to 300 days, and the average daily gain (240–480 days of age) is ~300–350 g/day. Slaughter weight of SNL pig ranges between 140 and 150 kg if the meat is intended for processing, while ranges between 110 and 125 kg if the meat is intended for direct consumption (E. Gambacorta, unpubl. data). This breed is much appreciated for the high quality of its niche products linked to the local gastronomic tradition, and it represents an example of the connection among local breed, territory and typical product, both fresh and seasoned. Regarding the meat quality of the SNL pig, to our knowledge, no information is reported in the literature. Therefore, considerations are possible only according to the knowledge available on the productive performances and meat quality of other Italian Mediterranean pig AAGTs (Fortina *et al*. 2005; Salvatori *et al*. 2008; Pugliese and Sirtori 2012). Since the SNL pig has not undergone selection programs, like all Mediterranean pig AAGTs, it is characterised by slow growth and a high fat depot compared with genetic lines currently used in pig farming (Franci and Pugliese 2007). The fatty acid composition of intramuscular fat of autochthonous pig is characterised by a high monounsaturated fatty acids (MUFA) concentration, mainly oleic acid, and a low polyunsaturated fatty acids (PUFA) concentration (Franci *et al*. 2005; Madonia *et al*. 2007). It is well known that the MUFA intake combines the advantages deriving from the cholesterol reduction with the decrease of low density lipoproteins and the inhibition of cell oxidation (Parthasarathy *et al*. 1990). The organoleptic characteristics such as flavour, aroma, tenderness, juiciness, and the dietary characteristics of the meat are affected by intramuscular fat content and composition (Mourot and Hermier 2001). Furthermore, fat and cholesterol contents and fatty acid composition are important because of their effects on human health. In fact, many studies reported that a high fat and cholesterol intake is associated with increased risk of colon cancer (Roynette *et al*. 2004) and cardiovascular disease (Jiménez-Colmenero *et al*. 2001). For this reason the World Health Organisation recommends limiting total fat intake to not more than 30%, with saturated fats no more than 10%, of daily energy intake (World Health Organization (WHO) 2003). The quantitative and qualitative characteristics of intramuscular fat were influenced by many factors, including weight at slaughter and muscle type (Salvatori *et al*. 2008; Realini *et al*.

2013). An increase in weight at slaughter increases intramuscular fat content and improves meat quality (Candek-Potokar *et al*. 2002). Furthermore, fat deposition and composition differs depending on the muscle fibre type, which is characterised by different metabolic properties (Cava *et al*. 2003). Skeletal muscle contains high concentrations of pro-oxidants (transition metals, haemcontaining proteins such as myoglobin, hemoglobin) therefore, it is particularly susceptible to oxidative reactions (Chan and Decker 1994). Vitamin E is the primary antioxidant in biological systems, capable of breaking the chain of lipid peroxidation (Young and Woodside 2001). It has a protective effect on the unsaturated fatty acids of muscle tissues (Barja *et al*. 1996) and reduces lipid oxidation, improving the qualitative characteristics and the nutritional value of meat, and also extending its shelflife (Morrissey *et al*. 1994). The vitamin E concentration in muscle tissue is also influenced by diet (González and Tejeda 2007). Rey *et al*. (2006) observed an increase in vitamin E levels in muscles from pigs reared in a free range system. The finality of this study was to increase knowledge on Suino Nero Lucano pig AAGT, for its better utilisation and greater diffusion on the territory. The aim of this work was to evaluate the nutritional quality of the lipid fraction of the meat through the study of two representative muscles (*Longissimus dorsi* and *Semitendinous*) of SNL pigs slaughtered at two different weights.

Materials and methods

Samples

A total of 96 Suino Nero Lucano pigs were used in this experiment. The pigs were raised, on the same farm of the province of Potenza (southern Italy), under a semi-wild system. To the animals, in addition to pasture (acorns and natural grasses), a grains mixture in the form of crushed (corn, barley and field beans, present in equal parts) was administered. The amount of concentrate fed to animals was calculated according to their daily requirements of maintenance, growth, more a portion for ambulation and equal to 70% of the estimated daily needs. The floristic composition of the pasture was determined according to Perna *et al*. (1997) method and was found to be composed of *Daucus carota*, *Plantago lanceolata*, *Bromus hordeaceus*, *Dactylis glomerata*, *Phleum pretense*, and *Lolium perenne*. Proximate composition of acorns, grass and concentrate (Table 1) was carried out according to Association of Official Analytical Chemists (AOAC 1995) procedures. The animals were allocated in two groups of 48 pigs each, and were slaughtered at two different weights (125 kg liveweight for light pigs and 150 kg liveweight for heavy pigs). When the pigs attained their target slaughter weight, they were transported to a commercial slaughterhouse where they were kept for a minimum of 12 h before slaughter. *Longissimus dorsi* (LD), at the level of the last lumbar to the first thoracic vertebra, and *Semitendinous* (ST) muscles from the right side of the carcass were excised at 24 h post-mortem from loin and ham respectively. Samples were vacuum packed and stored at −20°C until analysed.

Table 1. Proximate composition of concentrate (corn, barley and field beans, present in equal parts), grass and acorn
DM, dry matter

	Concentrate	Grass	Acorn
DM (% fresh matter)	87.28	24.37	61.05
Crude protein (% DM)	11.61	12.32	5.71
Ether extract (% DM)	2.37	2.54	6.64
Crude fibre (% DM)	3.43	23.29	3.70
Ash (% DM)	2.36	9.35	2.71
Nitrogen free extractives (% DM)	80.23	52.49	84.24

Chemical composition

Dry matter (DM), protein, fat, and ash contents of muscle samples were determined according to AOAC (1995) methods. All samples were analysed in duplicate.

HPLC analysis of total cholesterol and vitamin E

The saponification and extraction of total cholesterol and vitamin E was carried out as described by Prates *et al*. (2006), with some modifications. Briefly, for saponification, 0.75 g of homogenised meat sample was placed in a screw teflon lined cap tube to which 0.2 g L-ascorbic acid and 5.5 mL saponification solution were added. The saponification solution, freshly prepared each week, contained 11% (w/v) potassium hydroxide in a mixture of 55% (v/v) absolute ethanol and 45% (v/v) distilled water. The sample was then vortexed, degassed with nitrogen gas and shaken until the L-ascorbic acid was completely dissolved. The saponification was carried out in an ultrasound (US) water bath apparatus (Elma Transsonic 460/H, Singen, Germany) for 15 min at 80°C. After saponification, samples were cooled in water for 1 min. Following cooling 4 mL of n-hexane were added. The samples were vigorously vortexed for 2 min and centrifuged at 1500 *g* for 5 min, in order to accelerate phases separation. The upper layer containing n-hexane was transferred into vials of 5 mL capacity, evaporated to dryness and subsequently dissolved in 240 µL diethyl ether and 640 µL methanol before analysis by reverse phase HPLC. The analysis was performed in liquid chromatography equipped with Varian ProStar Pump model 210, Rheodyne injector with a 20 µL loop, UV-VIS detector Varian ProStar model 325, fluorescence detector Varian ProStar model 363 and using Galaxie™ Chromatography Software (Varian, Inc., Walnut Creek, CA, USA). The simultaneous analysis of total cholesterol and vitamin E in meat were performed using a Hypersil gold C18 column (250 × 4.6 mm, 5 µm) connected with a Hypersil gold guard column (10 × 4.0 mm, 5 µm) (Thermo Fischer Scientific, Milan, Italy), with fluorescence detection for vitamin E (excitation wavelength of 295 nm and emission wavelength of 325 nm) and UV-Vis detection for cholesterol (210 nm). The mobile phase was acetonitrile/methanol (55:45 v/v) at a flow rate of 1.0 mL/min, isocratically. The injection volume for all samples was 20 µL. Identification and quantification of the peaks were done by comparison with cholesterol and vitamin E standards (0.5–2.22 mg/mL and 0.2–1.4 mg/mL respectively). Results were expressed as mg/100 g fresh matter for total cholesterol and as µg/g fresh matter for vitamin E.

Determination of fatty acid profiles

Total lipids of the samples were extracted using hexane/2-propanol (3 : 2) according to Jiang *et al*. (1996), and fatty acid

methyl esters (FAMEs) were prepared according to the ISO (1978) method. Analysis was performed using a Varian 3400 gas chromatograph (Varian, Turin, Italy), equipped with a split-splitless injector, a TR-FAME capillary column (120 m × 0.25 mm i.d. × 0.25 μm film thickness; Thermo Fisher Scientific), a flame ionisation detector (FID) and a Galaxie™ Chromatography Software (Varian, Inc.) for chromatogram acquisition and data reporting. Helium was used as carrier gas, and the injector and detector temperatures were 250°C and 260°C respectively. The oven temperature program was 140°C for 5 min then increasing at 4°C/min up to 240°C where it was maintained for 15 min. Individual fatty acid methyl esters were identified by comparing their retention times with those of the corresponding pure standards (Sigma-Aldrich, Milan, Italy). Quantitative analysis was obtained by peak area integration using the Galaxie™ Chromatography Data System Version 1.9.3.2 software (Varian, Inc.) and results were expressed as percentage of the total fatty acids analysed. To evaluate the nutritional implications, both several fatty acid ratios such as SFA/UFA, PUFA/SFA, MUFA/SFA and hypocholesterolemic/hypercholesterolemic (h/H) ratios (Fernández *et al*. 2007), and atherogenic (AI) and thrombogenic (TI) indices, according to the formulae suggested by Ulbricht and Southgate (1991), were calculated.

Statistical analysis

Data were analysed according to the following linear model (SAS Institute 1996):

$$y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

where y_{ijk} is the observation; μ is the overall mean; α_i is the fixed effect of the *i*th slaughter weight (*W*) ($i = 1, 2$); β_j is the fixed effect of the *j*th muscle (*M*) ($j = 1, 2$); $(\alpha\beta)_{ij}$ is the interaction of weight at slaughter × muscle; and ε_{ijk} is the random error. Before setting the values, expressed in percentage terms, they were subjected to angular transformation. Student's *t*-test was used for all variables comparisons. Differences between means at the 95% ($P < 0.05$) confidence level were considered statistically significant.

Results and discussion

Chemical composition

Effect of weight at slaughter and muscle on chemical composition of the meat from SNL pigs is reported in Table 2. Overall, DM and protein contents detected in the present study in SNL meat were similar to those found by Zullo *et al*. (2003) in Casertana pigs (24.5 and 20.99 g/100 g respectively) and by Franci *et al*. (2005) in Cinta Senese pigs (26.77 and 22.80 g/100 g respectively), while fat content was higher in the studied samples (5.11 g/100 g *vs* 2.32 and 3.19 g/100 g detected by Zullo *et al*. (2003) and Franci *et al*. (2005) respectively), even if different analytical methods were used. Weight at slaughter influenced both DM and protein contents ($P < 0.001$), that, as expected, were higher in heavy pigs (+ 3.8 and + 5.3% respectively) than in the light ones. No significant effect related to weight at slaughter was found regarding fat content, in disagreement with what was reported by Friesen *et al*. (1995), who showed that fat deposition increases with increasing bodyweight. The similar fat content found in light and heavy pigs could be due to the fact that at the slaughter time they were still in the growth phase, consequently, the energy utilisation was still finalised to formation of new tissues. However, a slightly higher fat content was found in light pigs, in agreement with what was reported by other authors in Casertana pigs AAGT (Zullo *et al*. 2003; Salvatori *et al*. 2008). Muscle influenced the DM, protein, and ash contents ($P < 0.001$). The anatomical location affects the muscle composition (Muriel *et al*. 2002) and it is mainly due to metabolic differences (Andrés *et al*. 2001). LD muscle showed a higher DM and protein contents, while ST muscle showed a higher ash content, in agreement with what was reported by Zullo *et al*. (2003). Muscle also strongly influenced the fat content ($P < 0.001$), being higher in LD than in ST muscle. It is well known that lipid content is higher in red oxidative muscle fibres, and LD muscle of pigs is relatively red and differently involved in the physical activity imposed by grazing in comparison with the ST muscle (Vestergaard *et al*. 2000; Taylor 2004); though other authors (Leseigneur-Meynier and Gandemer 1991; Kang *et al*. 2011) found no association between total lipid content and type of muscular metabolism.

Cholesterol

Effect of weight at slaughter and muscle on total cholesterol content of the meat from SNL pigs is reported in Table 2. The average total cholesterol content (37.37 mg/100 g meat) was similar to that found both in other AATGs (Salvatori *et al*. 2008; Stajić *et al*. 2011) and in commercial pigs (Piironen *et al*. 2002; Bragagnolo 2009). No significant effect related to

Table 2. Effect of weight at slaughter and muscle on chemical composition, total cholesterol and vitamin E contents of the meat from Suino Nero Lucano pigs

LD, *Longissimus dorsi*; s.e.m., standard error of means; ST, *Semitendinosus*. Significant at $P < 0.05$

	Weight at slaughter (*W*)		Muscle (*M*)		s.e.m.	*P*-value		
	Light	Heavy	LD	ST		*W*	*M*	*W* × *M*
No. of samples	96	96	96	96				
Dry matter (g/100 g meat)	26.57	27.59	29.72	24.44	0.53	0.000	0.000	0.100
Fat (g/100 g meat)	5.14	5.07	7.06	3.15	0.38	0.524	0.000	0.937
Protein (g/100 g meat)	20.27	21.35	21.51	20.11	0.20	0.000	0.000	0.007
Ash (g/100 g meat)	1.09	1.09	1.05	1.13	0.01	0.607	0.000	0.005
Cholesterol (mg/100 g meat)	36.81	37.93	41.22	33.52	1.77	0.410	0.031	0.083
Vitamin E (μg/g meat)	2.70	2.73	2.69	2.74	0.03	0.284	0.063	0.024

weight at slaughter was found regarding total cholesterol content (Table 2). Salvatori *et al*. (2008), in Casertana pigs, reported a reduction in the cholesterol content with increasing of weight at slaughter. Total cholesterol content was influenced by muscle ($P < 0.05$), being higher in LD (+23%) than in ST muscle. This result confirms those reported by Chizzolini *et al*. (1999), who showed that the muscle is among the factors that most influence the total cholesterol content.

Vitamin E

Effect of weight at slaughter and muscle on vitamin E content of the meat from SNL pigs is reported in Table 2. The vitamin E content ranged between 2.69 and 2.74 μg/g meat with a mean content of 2.72 μg/g meat (Table 2). These results are in line with those found by Tejerina *et al*. (2012*a*, 2012*b*) in *Longissimus dorsi* muscle of Iberian pigs. No information was found in the literature on the vitamin E content of the meat from Italian pig AAGTs. No significant effects related to weight at slaughter or muscle were found regarding vitamin E content, in disagreement with Tejerina *et al*. (2012*b*), who found a significant effect of muscle on vitamin E content. In our study, a slightly higher content was found in ST muscle, in agreement with what was reported by Realini *et al*. (2013) in commercial pigs. On the basis of a daily consumption of a 150 g steak, trimmed of all visible fat, SNL meat provides 56 mg of cholesterol and 0.41 mg of vitamin E, which represent 18.7% of the daily maximum recommended for cholesterol (<300 mg/die; USDA 2012), and 2.7% of recommended allowance for vitamin E (15 mg/die; Food and Nutrition Board 2000). Finally, significant effect related to weight at slaughter × muscle interaction was detected on protein, ash ($P < 0.01$) and vitamin E contents of the meat ($P < 0.05$; Table 2).

Fatty acids profile

Meat quality is closely linked to the fatty acid composition of intramuscular fat. Effect of weight at slaughter and muscle on fatty acid composition (%) of the meat from SNL pigs is reported in Table 3. Concerning the fatty acid classes, except for SFA, significant effects related to weight at slaughter were detected. These findings are in line with those reported by Salvatori *et al*. (2008), who showed that weight at slaughter significantly affected the fatty acid profile of intramuscular fat. Also, the above mentioned authors detected that PUFA content increased with increasing slaughter weight, on the contrary in our study, PUFA n-3 and PUFA n-6 contents decreased with increasing weight ($P < 0.001$), in agreement with what was reported by Raj *et al*. (2010) in several pig breeds slaughtered at different liveweights. This result confirms the trend towards an increase of the saturation degree of the adipose tissue with the increasing weight, as reported by other authors (Enser 1991; Nürnberg *et al*. 1998). Furthermore, a marked weight related effect ($P < 0.001$) was detected on C18:1 n-9 (cis) content, which was higher in the heavy pigs than in the light ones, in agreement with other authors (Salvatori *et al*. 2008; Raj *et al*. 2010). The muscle markedly influenced the contents of total SFA, PUFA ($P < 0.001$), and MUFA ($P < 0.01$; Table 3). Similarly, in a study on Iberian pig muscles, Morcuende *et al*. (2003) and Tejerina *et al*. (2012*b*) found differences in the fatty acid profiles of intramuscular fat of muscles with different metabolic pattern.

Table 3. Effect of weight at slaughter and muscle on fatty acid composition (%) of the meat from Suino Nero Lucano pigs

LD, *Longissimus dorsi*; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; s.e.m., standard error of means; SFA, saturated fatty acids; ST, *Semitendinosus*. Significant at $P < 0.05$

	Weight at slaughter (*W*)		Muscle (*M*)		s.e.m.	*P*-value		
	Light	Heavy	LD	ST		*W*	*M*	*W* × *M*
No. of samples	96	96	96	96				
C14:0	1.85	1.84	2.03	1.66	0.051	0.781	0.000	0.029
C14:1	0.04	0.05	0.04	0.04	0.003	0.001	0.267	0.225
C15:0	0.05	0.06	0.05	0.06	0.002	0.001	0.001	0.151
C16:0	25.69	26.64	27.37	24.95	0.368	0.000	0.000	0.335
C16:1	4.74	4.36	4.88	4.22	0.141	0.001	0.001	0.007
C17:0	0.27	0.25	0.21	0.31	0.014	0.191	0.000	0.101
C17:1	0.24	0.23	0.22	0.25	0.009	0.214	0.001	0.000
C18:0	14.42	13.22	14.92	12.71	0.393	0.000	0.000	0.118
C18:1 n-9 (trans)	0.25	0.24	0.25	0.24	0.022	0.199	0.583	0.309
C18:1 n-9 (cis)	34.36	36.28	36.04	34.60	0.450	0.000	0.000	0.000
C18:1 n-11 (cis)	5.74	5.28	5.57	5.44	0.145	0.001	0.205	0.001
C18:2 n-6 (cis)	8.72	7.92	5.65	10.99	0.553	0.000	0.000	0.041
C18:3 n-3	0.41	0.33	0.30	0.44	0.023	0.001	0.001	0.001
C20:0	0.20	0.16	0.20	0.16	0.009	0.001	0.001	0.000
C20:1 n-9	1.04	0.88	0.98	0.94	0.035	0.000	0.161	0.001
C20:3 n-6	0.32	0.24	0.22	0.35	0.022	0.001	0.001	0.092
C20:4 n-6	0.19	0.20	0.13	0.26	0.014	0.098	0.001	0.003
C22:0	1.48	1.83	0.92	2.38	0.160	0.001	0.000	0.001
SFA	43.96	44.00	45.72	42.24	0.555	0.907	0.000	0.214
MUFA	46.40	47.31	47.98	45.72	0.434	0.007	0.004	0.922
PUFA	9.64	8.69	6.30	12.04	0.601	0.000	0.000	0.036
PUFA n-6	9.24	8.36	6.00	11.60	0.583	0.001	0.000	0.059
PUFA n-3	0.41	0.33	0.30	0.44	0.023	0.000	0.000	0.001

In our study, LD muscle, compared with the ST muscle, showed a higher total SFA content, due to a higher proportion of C14:0, C16:0 and C18:0 acids; a higher total MUFA content, due to higher contents of both C16:1 ($P < 0.01$) and C18:1 n-9 (cis) ($P < 0.05$) acids; and lower amounts of both C18:2 n-6 (cis) and C18:3 n-3 acids and, consequently, of total PUFA n-6 and PUFA n-3. These results are in line with those reported by Realini *et al*. (2013) in commercial pig muscles. SFA are mainly located in the triacylglycerols and PUFA in the phospholipids, consequently, the muscle effect is largely explained by the higher triacylglycerol/phospholipid ratio in the relatively red Ld muscle when compared with the relatively white ST muscle. Many authors (Lo Fiego 1996; De Smet *et al*. 2004) also reported that the fatty acid composition of muscle reflects its fat content, in particular, the greater the fat deposition, the more saturated the fat. Other authors (Leseigneur-Meynier and Gandemer 1991; Cava *et al*. 2003) reported that the PUFA content increase with the oxidative activity of the muscles and appears to depend on the metabolic type. No significant effect related to weight at slaughter × muscle interaction was found regarding total SFA, MUFA, and PUFA n-6 contents (Table 3), despite significant differences in some individual fatty acids. In particular, the content of C16:1 acid was higher in LD muscle of light pigs (5.41%; $P < 0.01$) compared with the heavy ones (4.34%) and to ST muscle (4.06 and 4.37, for light and heavy pigs respectively), while the content of C18:1 n-9 (cis) was higher in LD muscle of heavy pigs (37.82%; $P < 0.001$) compared with light ones (34.26%) and to ST muscle (34.46 and 34.73%, for light and heavy pigs respectively). Many parameters are used to evaluate the nutritional quality of the lipid fraction of foods. PUFA/SFA ratio is recommended nowadays to be above 0.40 in order to prevent both an excess of some SFA that have a negative effect on the LDL cholesterol plasmatic level, and an excess of some PUFA, that are precursors of powerful clotting agents and also being involved in the aetiology of some cancers (Department of Health 1994). However, PUFA/SFA ratio may not be completely suitable to evaluate the nutritional value of fat because ignores the effect of MUFA, such as C18:1 n-9 (cis) the content of which is high in pig AAGT, and overestimates the effect of some SFA such as C18:0 that do not increase plasma cholesterol (Santos-Silva *et al*. 2002). Therefore, it is necessary to use other nutritional indices as PUFA n-6/PUFA n-3 ratio that should not exceed 4.0 (Department of Health 1994) to avoid the prothrombotic and proagregatory state induced by a high level of n-6 PUFA (Simopoulos 1999); hypocholesterolemic/hypercholesterolemic (h/H) ratio; atherogenic index (AI) and thrombogenic index (TI) which best define the dietetic properties of the meat (Ulbricht and Southgate 1991; Santos-Silva *et al*. 2002; Jankowska *et al*. 2010). The effect of weight at slaughter and muscle on nutritional indices and fatty acid ratios of SNL meat is reported in Table 4. No significant effects related to weight at slaughter or muscle were found regarding MUFA/SFA ratio. PUFA/SFA ratio was lower in LD muscle than ST ($P < 0.001$), and in the light pigs than in the heavy ones ($P < 0.001$), showing a mean value of 0.24, while SFA/UFA ratio was lower in ST muscle than LD ($P < 0.001$) showing a mean value of 0.80. These mean values were similar to those found by Salvatori *et al*. (2008) in intramuscular fat of Casertana pig meat. PUFA/SFA ratio, found in our samples, was below the nutrition recommendations (Department of Health 1994). h/H ratio assesses the ratio between hypocholesterolemic (sum of 18 : 1, 18 : 2, 18 : 3) and hypercholesterolemic (sum of 14 : 0, 16 : 0) fatty acids (Santos-Silva *et al*. 2002). In this study, h/H ratio ranged between 1.44 (LD muscle) and 1.54 (ST muscle), and was below the limits defined by Department of Health (1994). LD muscle showed a higher H value than ST ($P < 0.001$). The muscle markedly influenced the PUFA n-6/PUFA n-3 ratio ($P < 0.001$), being higher in ST (+38%) because of the higher content of C18:2 n-6 (cis), than in LD muscle. No significant effect related to weight at slaughter was found regarding this ratio. Our samples showed a PUFA n-6/PUFA n-3 ratio well above the recommended value of less than 4.0 (Department of Health 1994). This was due to the high content of C18:2 n-6 (cis) which positively affected the PUFA/SFA ratio and negatively influenced the PUFA n-6/PUFA n-3 ratio. C18:2 n-6 (cis) is the precursor of C20:4 n-6, which is considered advantageous for cardiovascular health of the consumer only when present in low amounts, being antagonist of the health benefits resulting from n-3 fatty acids (Parra *et al*. 2007). In this study, average C20:4 n-6 content was lower than

Table 4. Effect of weight at slaughter and muscle on nutritional indices and fatty acid ratios of the meat from Suino Nero Lucano pigs

AI, atherogenic index; h, hypocholesterolaemic (sum of 18:1, 18:2, 18:3); H, hypercholesterolaemic (sum of 14:0, 16:0); LD, *Longissimus dorsi*; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; s.e.m., standard error of means; SFA, saturated fatty acids; ST, *Semitendinosus*; TI, thrombogenic index; UFA, unsaturated fatty acids. Significant at $P < 0.05$

	Weight (*W*)		Muscle (*M*)		s.e.m.	*P*-value		
	Light	Heavy	LD	ST		*W*	*M*	*W* × *M*
No. of samples	96	96	96	96				
SFA/UFA	0.79	0.79	0.85	0.74	0.017	0.867	0.001	0.228
PUFA/SFA	0.23	0.20	0.14	0.29	0.016	0.000	0.001	0.062
MUFA/SFA	1.06	1.08	1.05	1.09	0.020	0.382	0.073	0.366
h	40.75	42.12	42.16	40.71	0.419	0.227	0.089	0.003
H	27.54	28.48	29.40	26.61	0.403	0.058	0.001	0.529
h/H	1.49	1.49	1.44	1.54	0.028	0.108	0.000	0.120
PUFA n-6/PUFA n-3	22.56	25.48	20.20	27.84	1.026	0.761	0.000	0.001
AI	0.59	0.61	0.66	0.55	0.014	0.178	0.001	0.549
TI	1.46	1.46	1.59	1.32	0.027	0.853	0.001	0.364

that reported by Raj *et al*. (2010). AI and TI indicate the different effects that the single fatty acid might have on human health, in particular, AI assesses the risk of atherosclerosis, while TI evaluate the potential aggregation of blood platelets (Ulbricht and Southgate 1991). Overall, AI and TI values, found in our samples, were similar to that found by Salvatori *et al*. (2008) in Casertana pigs. The muscle markedly influenced AI and TI ($P < 0.001$). LD muscle showed higher AI and TI than ST, due to higher contents of both C14:0 and C16:0 acids, as well as to lower PUFA content. No significant effects related to weight at slaughter and weight at slaughter × muscle interaction were detected regarding both AI and TI.

Conclusion

The results of this study show that meat from Suino Nero Lucano pigs AAGT, like that of all autochthonous pigs, has a high IMF content with higher proportion of UFA than SFA due to the high MUFA content, represented mainly by the oleic acid which plays an important role from a nutritional point of view. Weight at slaughter and muscle influenced the fatty acid composition of intramuscular fat with consequences on dietetic properties of the meat. Despite the need for further study, from our findings about muscle and weight at slaughter, meat production with specific nutritional characteristics is a possibility. Moreover, we think that this work, carried out on the raw product, must be at the basis of studies that have to consider the product after the thermal process of preparation.

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