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Research article

Characteristics of carcass, meat and subcutaneous fat of Mangalica pigs reared outdoors

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Abstract

Importance of the work: Mangalica pig meat has a reputation for superior quality. Little information is available on this breed reared for heavy pig production.

Objectives: To evaluate the effects of sex on the carcass, loin and lard characteristics (inner and outer layers) of Blonde Mangalica pigs.

Materials & Methods: In total, 15 Blonde Mangalica pigs were considered (10 castrated males and 5 females) that were reared together outdoors. The pigs had *ad libitum* access to the same diet and were slaughtered at age 22.9 mth, with an average carcass weight of 141.4 kg.

Results: Sex did not affect the carcass, meat or lard characteristics. In general, the Mangalica pigs had an average fat thickness of 70 mm and a loin cholesterol content of 0.674 mg/g. The loin had 39.0%, 52.5% and 8.5% saturated (SFA), monounsaturated fatty acids and polyunsaturated fatty acids (PUFA), respectively. Significant differences were found in the characteristics of the two lard layers. In particular, the inner layer was brighter and had a higher dry matter content than the outer layer. Regarding the fatty acids content, the inner layer had a lower PUFA but higher SFA content.

Main finding: Sex did not influence the carcass, meat or lard characteristics of the Mangalica pigs. The results improved the characterization and filled knowledge gaps regarding meat and lard quality parameters of heavy Mangalica pigs reared outdoors.

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Introduction

Currently, the choice of meat products depends not only on perceived quality or convenience, but also on nutritional quality, animal welfare and the degree of impact of the production system on the environment (Appleby et al., 2004). These are reasons why the demand for food obtained from organic or environmental-friendly production systems has increased in recent years. In this regard, many rustic breeds have been revived in European pig farming, which, with a view to the conservation and development of agro-biodiversity, enhances marginal lands and ensures the production of high-quality meat. In addition, the ability is positively evaluated of autochthonous/rustic breeds to adapt to these environments and their resistance to diseases and unfavorable climatic conditions. One example of niche breeding is the Mangalica breed, a rustic/unselected breed native to Hungary. The rediscovery of the autochthonous breeds and the attention to a "low input" breeding program have allowed this breed to expand in the European territory and ensure its conservation status (Egerszegi et al., 2003).

The Mangalica breed is characterized by late maturity, low fertility, a slower growth rate and higher adiposity than other pig breeds, with up to 65–70% of the average carcass mass being lard (Egerszegi et al., 2003). On the other hand, the meat of this breed has a reputation for superior quality (Imrich et al., 2019). Although many studies have evaluated the meat characteristics of these animals, Petroman et al. (2021) stated that more information is needed on the fatty acid (FA) profile. Recently, Charlton et al. (2022) and Roberts et al. (2023) studied the growth performance and carcass characteristics or meat quality of indoor-reared Mangalica pigs. However, both studies obtained light carcasses (within 95 kg). The Italian pig sector is primarily and traditionally represented by heavy pig production, with carcasses of about 130–140 kg (Bava et al., 2017); only female or castrated male pigs are used in this production system. From this point of view, it seems that little information has been published on the effect of sex on meat quality in Mangalica pigs. Therefore, the knowledge obtained in the present research should help in the assessment of the potential of this rustic breed to produce high-quality meat in the heavy pig breeding system.

The study aimed to examine the carcass characteristics and meat and lard quality of heavy Mangalica pigs reared outdoors according to sex, while considering the FA composition of the lard in different layers.

Materials and Methods

Ethics statements

The study was conducted according to EU Directive 2010/63/EU. Since the procedures adopted were routine, no formal approval was required.

Animals

In total, 15 Blonde Mangalica pigs (5 female and 10 castrated males) were considered. The animals were reared together outdoors in a paddock (1 ha) on a farm and were slaughtered at the average age of 22.9 mth which was similar between sexes ($p > 0.05$). Inside the paddock were wooden shelters for the animals, with covered feeders and troughs. Pigs were fed with a concentrated pelleted feed, made up of maize, wheat bran, feed based on hulled soybean flour, wheat bran, wheat flour, barley, calcium carbonate, dicalcium phosphate, sodium chloride, vegetable oils and fats (palm oil). The chemical composition of this concentrate was: dry matter (DM): 88.6%; ashes: 6.31% DM; neutral-detergent fibers (NDF): 15.18% DM; ether extract: 5.29% DM; and crude proteins: 16.36% DM (more details in Table S1). Pigs had *ad libitum* access to feed and water.

Measurements and sampling

After a 12 hr fasting period, the animals were slaughtered in an EU-licensed slaughterhouse about 25 km from the farm, in accordance with national regulations and under procedures controlled and approved by a veterinarian. The pigs were slaughtered using electrical stunning, and the carcasses were kept at 4°C.

At 45 min after slaughter, the pH values of the *gluteus medius* m. and the *semimembranous* m. were recorded using an HI 8424 pH meter (Hanna Instruments; PD, Italy) equipped with a pH 52–32 probe (Crison Instruments; Barcelona, Spain). The hot carcass weight was measured, including the head but excluding the offal. The thickness of the *gluteus medius* m. was measured from the cranial tip of the muscle to the vertebral canal, while the thickness of fat adhering to the muscle was recorded at the minimum point of coverage, following the ZP-Measuring method used for SEUROP evaluations of European pig carcasses (Lisiak et al., 2015). Samples of the *longissimus lumborum* m. (loin) and the corresponding

subcutaneous fat (lard) were collected and kept at 4°C.

At 24 hr post-mortem, the muscle and adipose tissues were separated and cleaned. The lard was divided into two parts: one more external and compact, adhering to the skin (outer lard), with the other more internal and softer, adhering to the muscle (inner lard). Three samples were analyzed for each pig: loin, inner and outer lard. The ultimate pH (pHu) was measured as previously described. After a blooming time of 30 min, color values were measured on loin and fat (inner and outer) using a Spectrophotometer Konica Minolta CM 2600 d (Chiyoda; Tokyo, Japan) with an eight mm opening window, Standard Illuminant D65 as the light source and 10° viewing angle geometry. The color values recorded were the L* (lightness), a* (redness) and b* (yellowness) scores, according to the Commission International De I'Eclairage (1976). Samples were collected from each animal and tissue for chemical composition and gas-chromatographic analyses and kept at -20°C. Additional loin samples were collected from each animal to analyze drip loss, cooking loss and Warner Bratzler shear force (WBSF). In particular, drip loss was evaluated according to the EZ-Driploss modified method (Rasmussen and Andersson, 1996). Then, 2–5 muscle cylinders (25 mm diameter and 25 mm high) were added to EZ-Driploss containers. They were maintained for 72 hr at 4°C. Each container was weighed before and after the meat was inserted. After 72 hr, the meat was extracted from the funnel and reweighed with the liquid collected inside it. The drip loss was expressed as a percentage of the fresh weight of each sample (cylinder of meat). Cooking loss and WBSF analysis were performed according to Ncogo Nchama et al. (2022).

Chemical analysis

The methods of Association of Official Analytical Chemists (2016) were followed. About 100 g of loin were ground, freeze-dried and subjected to the determination of moisture, ash, crude protein and ether extract (lipids) contents. For the lard (inner and outer), moisture, ashes and lipid contents were determined. The total muscle hydroxyproline content (HPro) was determined using the commercial hydroxyproline assay kit (Cat. N. MAK008; Sigma-Aldrich; St. Louis, MO, USA) and total collagen was obtained by multiplying the HPro content by 7.25 (Goll et al., 1963). Insoluble collagen was extracted from lyophilized muscle following the method of Palka (1999). Then, the HPro content in this fraction was determined using the previously cited commercial kit. Subsequently, the insoluble collagen content in the fresh meat was calculated based on the water content lost from the sample through freeze-drying. The soluble collagen content was obtained by subtracting the insoluble collagen from the total collagen.

Fatty acids analysis

Lipid extraction from meat and lard was performed, as reported in Pianezze et al. (2021). The fatty acid methyl esters (FAMEs) were obtained following the method described by Sukhija and Palmquist (1988) and as reported in Ncogo Nchama et al. (2022). Gas chromatography-mass spectrometry (GC/MS) analyses were carried out as reported in Pianezze et al. (2021) with some modifications. In particular, 1 µL was injected in split mode (1:100), and the GC oven program was 1 min at 50°C. Then, the temperature regime was increased by 8°C/min to 160°C (hold time 3 min), 5°C/min to 200°C (hold time 1 min) and 15°C/min to 240°C (hold time 5 min). Each run lasted 40 min. The National Institute of Standards and Technologies Mass Spectral Library (NIST, 2014) was used to identify the different compounds. C21:0 was the internal standard and FAME was expressed as a percentage of the total FA identified.

Cholesterol analysis

Cholesterol determination was performed based on direct saponification in KOH following the method of Naeemi et al. (1995). In the extraction step, 5α-cholestane was used as an internal standard. FA was quantified based on chromatographic runs performed using the GC/MS 5977E, but with a nonpolar stationary phase (5%-phenyl) methylpolysiloxane and HP-5ms column with dimensions of 30 m × 0.25 mm × 0.25 µm (Agilent Technologies; Santa Clara, CA, USA). The run lasted 19 min, with a starting temperature of 200°C and an increase of 10°C/min to 280°C, maintained for 10 min. The ion source and quadrupole temperatures were set similarly to those used for FA detection.

Statistical analysis

Data analyses were performed using the SPSS software program (vers. 17; SPSS Inc.; Chicago, IL, USA) and the R software package, version 4.1.2 (R Core Team, 2021). Data related to the carcass and meat composition and quality were analyzed according to a one-way analysis of variance evaluating the effect of sex (female versus castrated). The data relating to the composition of the lard were processed according to a model for repeated measures, where the layer (inner versus outer) and the sex (female versus castrated) were considered as

within and between factors, respectively. Furthermore, interaction of interaction layer × sex was considered. A similar model, but considering muscle type (*gluteus medius* m. *vs. semimembranousus* m.) instead of layer (as within factor), was considered for the pH. The FAs of the loin and the inner and outer layers of subcutaneous fat were processed based on bi-plot analysis using the factoextra package (Kassambara and Mundt, 2020). The test level for significance was set at $p < 0.05$.

Results and Discussion

The carcass, meat and subcutaneous fat characteristics of Mangalica pigs are shown in Table 1.

Heavy pigs are slaughtered at a minimum age of 9–10 mth when the carcass weight is approximatively 130–140 kg, thus achieving optimal meat characteristics (Lo Fiego et al., 2005, 2010; Bava et al., 2017). In the present trial, the Mangalica pigs were slaughtered at age 23 mth and had a hot carcass weight of 141 kg. The later age at which these animals reached the target carcass weight could have been related to the higher energy expenditure associated with outdoor-rearing conditions and the slow growth rates of Mangalica pigs (Roberts et al., 2023). There was no significant effect of sex on carcass characteristics. The average estimated lean meat was much lower than that observed in commercial crossbreeds, by about 50% (Latorre et al., 2003; Pesenti Rossi et al., 2022), confirming that Mangalica is a breed with high-fat deposition (Egerszegi et al., 2003). The *gluteus medius* m. had a significantly higher pH45 than the *semimembranousus* m., while the effect of sex was not significant, which could have been due to the different fiber compositions of the muscles. Fast-twitch glycolytic fibers promote glycolysis with a rapid pH decline (Choe et al., 2008); whereas, oxidative fibers reduce the pH decline (Choi et al., 2007). There were no significant differences in the characteristics of the *longissimus lumborum* m. (loin) between the females and castrated males. The pHu of the loin was within the normal range (5.3–5.8), as reported by Stanišić et al. (2016). Sex did not significantly affect loin color, drip loss, cooking loss or WBSF. In agreement with the present study, Peinado et al. (2012) failed to find differences in color characteristics, drip loss, cooking loss or shear force when comparing castrated

Table 1 Effect of sex, muscle or lard layer on carcass, meat and subcutaneous fat characteristics of Mangalica pig

Item		Within pig factor	Sex		MSE	Significance		
			Female	Castrated		Sex	WPF	Sex × WPF
Hot carcass weight	kg		137.0	145.8	5.72	0.458		
ZP-method:								
subcutaneous fat thickness	mm		71	69	2.00	0.554		
muscle thickness	mm		61	58	1.46	0.318		
estimated lean meat[1]	%		26.5	27.5	1.024	0.635		
Lean meat								
pH 45'	*gluteus medius*	6.41^{A}	6.33	6.23	0.037	0.188	< 0.001	0.713
	semimembranousus	6.16^{B}						
Loin (*longissimus lumborum* m.)								
pHu			5.48	5.58	0.070	0.474		
L*			39.42	38.79	1.021	0.767		
a*			7.07	7.23	0.507	0.878		
b*			12.66	12.15	0.397	0.530		
Drip loss	%		4.75	4.86	0.424	0.900		
Cooking loss	%		26.8	26.9	1.18	0.980		
WBSF	N		43.7	41.5	2.70	0.687		
Subcutaneous fat (lard, lumbar region)								
pHu	Inner layer	6.83	6.85	6.87	0.045	0.832	0.079	0.650
	Outer layer	6.88						
L*	Inner layer	73.63^{A}	73.01	73.01	0.257	0.997	0.004	0.181
	Outer layer	72.39^{B}						
a*	Inner layer	-0.79	-0.80	-0.58	0.093	0.260	0.399	0.688
	Outer layer	-0.60						
b*	Inner layer	6.72^{a}	6.15	6.26	0.327	0.865	0.029	0.778
	Outer layer	5.70^{b}						

pHu = ultimate pH; ^{A,B} = highly significant at $p < 0.01$; ^{a,b} = significant at $p < 0.05$; [1] estimated lean meat = 57.7975 – 0.5126 x1 + 0.0834 x2 where x1 = subcutaneous fat thickness and x2 = muscle thickness.

male and female Ibernian pigs with about 102 kg carcass weight. The present results had a lower average loin lightness (L*) and a redness (a*) higher than that observed in commercial heavy pig breeds, which averaged 48–50 and 2–4, respectively (Latorre et al., 2003; Virgili et al., 2003; Suárez-Belloch et al., 2016). As explained by Stanišić et al. (2016), the level of a* is related to the muscle myoglobin and deoxymyoglobin (Mb) contents, with high muscle activity leading to increased myoglobin levels. WBSF had an average value of 42.6 N, while values in the literature for pork averaged around 30 N (Van Oeckel et al., 1999). The reasons for this greater meat firmness of Mangalica pigs were likely because the animals were raised outdoors, with constant physical activity changing the muscle structure, both at the level of myofibrils and the collagen protein network, and reducing meat tenderness (Olsson and Pickova, 2005). Lard pH and color were not significantly affected by sex; however, the inner layer had a highly significantly ($p < 0.01$) greater L* value than the outer layer. These differences were consistent with the higher SFA level observed in the inner layer (Table 3). In fact, a high melting point can lead to whiter fat (Wood et al., 2004; Carrapiso and García, 2005).

Male castration did not significantly affect the chemical composition of the meat and subcutaneous fat (Table 2). Vranic et al. (2015), considering Mangalica free-range reared pigs, reported that the *longissimus dorsi* m. of castrated males had a similar chemical composition to that of females, except for moisture and total fat that were lower and higher, respectively, in castrated males; however, these pigs had a much lower carcass weight (76 kg) than that considered in the present study. Conversely, Peinado et al. (2012) did not report any effect of sex on meat chemical composition. In the present study, the average fat content in the meat was within the range reported for the Mangalica breed of approximately 6–17% (Parunović et al., 2013; Despotović et al., 2018), which is high compared to the ideal range for consumer purchase intentions of approximately 2.5–3.5% (Fernandez et al., 1999; Despotović et al., 2018) and is much higher than that observed for heavy pigs of genetically improved breeds of approximately 2–4% (Latorre et al., 2003; Virgili et al., 2003; Parunović et al., 2013). The chemical composition of the inner fat layer was not significantly different to the outer layer, with the only exception being dry matter, which was significantly higher in the inner layer, in agreement with Moody and Zobrisky (1966).

Sex did not significantly influence the FA composition of subcutaneous fat (Table 3), in agreement with Peinado et al. (2012). Conversely, Grela et al. (2013) showed that females had higher C18:2n-6 and C20:2n-6 contents but a lower C18:0 content than castrated males. The lard layer influenced the FA composition (Table 3). In particular, the inner layer had significantly higher C16:0 and C20:0 contents, but significantly lower C15:1, C17:0, C17:1, C18:2n-6, C18:3n-3, C20:2, C20:3n-3 and C20:4n-6 contents than the outer layer. Considering the FA groups, the inner layer had significantly more SFA, but significantly fewer polyunsaturated FAs (PUFA), both in terms of total n-3 and n-6, than the outer layer.

Table 2 Effect of sex or lard layer on chemical composition of meat and subcutaneous fat of Mangalica pigs

Item		Within pig factor	Sex		MSE	*p*-Value		
			Female	Castrated		Sex	WPF	Sex × WPF
Loin (*longissimus lumborum* m.) % fresh meat:								
Water	%		70.0	69.3	0.568	0.570		
Ash	%		1.13	1.11	0.011	0.287		
Crude protein	%		21.6	21.3	0.188	0.490		
Total collagen	mg/g		2.96	3.04	0.083	0.634		
Soluble collagen	% total		33.6	36.0	2.749	0.673		
Total fat	%		7.01	8.13	0.686	0.429		
Cholesterol	mg/g		0.668	0.681	0.02	0.710		
Subcoutaneous fat (lard, lumbar region) % fresh meat:								
Dry matter	Inner layer	96.6[a]	96.4	96.2	0.137	0.426	0.042	0.685
	Outer layer	95.9[b]						
Ash	Inner layer	0.049	0.053	0.044	0.0038	0.249	0.851	0.205
	Outer layer	0.048						
Total fat	Inner layer	84.1	83.3	83.4	0.618	0.904	0.346	0.583
	Outer layer	82.6						
Cholesterol (mg/g)	Inner layer	0.901	0.912	0.924	0.0180	0.756	0.227	0.086
	Outer layer	0.935						

MSE = mean standard error; [a, b] = significant at $p < 0.05$.

Table 3 Effect of sex or lard layer on fatty acid composition of subcutaneous fat of Mangalica pigs (% of total lipids)

Fatty acid	Layer		Sex		MSE	*p*-Value		
			Female	Castrated		Sex	Layer	Sex × Layer
C10:0	Inner	0.05	0.05	0.05	0.003	0.783	0.411	0.369
	Outer	0.05						
C12:0	Inner	0.08	0.08	0.08	0.003	0.889	0.984	0.618
	Outer	0.08						
C14:0	Inner	1.67	1.63	1.68	0.036	0.560	0.664	0.832
	Outer	1.64						
C15:1	Inner	0.037^{b}	0.040	0.042	0.0020	0.669	0.013	0.907
	Outer	0.044^{a}						
C16:0	Inner	22.80^{A}	22.36	22.34	0.205	0.953	<0.001	0.471
	Outer	21.90^{B}						
C16:1n-7	Inner	0.45	0.43	0.44	0.020	0.896	0.277	0.922
	Outer	0.42						
C16:1n-9	Inner	2.22	2.21	2.19	0.078	0.862	0.781	0.235
	Outer	2.18						
C17:0	Inner	0.28^{b}	0.29	0.31	0.009	0.463	0.018	0.709
	Outer	0.32^{a}						
C17:1	Inner	0.22^{B}	0.24	0.29	0.013	0.066	0.004	0.063
	Outer	0.31^{A}						
C18:0	Inner	15.40	14.71	14.86	0.274	0.778	0.097	0.278
	Outer	14.17						
C18:1n-9	Inner	37.36	37.62	36.95	0.512	0.531	0.839	0.435
	Outer	37.21						
C18:1n-7	Inner	2.38	2.45	2.43	0.080	0.897	0.501	0.605
	Outer	2.50						
C18:2n-6	Inner	11.88^{B}	12.39	13.02	0.276	0.280	0.005	0.846
	Outer	13.53^{A}						
C20:0	Inner	0.32^{A}	0.32	0.30	0.009	0.294	0.006	0.042
	Outer	0.29^{B}						
C18:3n-3	Inner	0.76^{b}	0.80	0.85	0.031	0.394	0.043	0.537
	Outer	0.89^{a}						
C20:1n-9	Inner	2.17	2.17	2.17	0.120	0.999	0.985	0.963
	Outer	2.17						
C20:2	Inner	1.13^{B}	1.22	1.29	0.055	0.543	<0.001	0.817
	Outer	1.39^{A}						
C20:3n-6	Inner	0.12	0.15	0.11	0.010	0.067	0.335	0.745
	Outer	0.13						
C20:3n-3	Inner	0.25^{B}	0.31	0.27	0.012	0.143	<0.001	0.844
	Outer	0.33^{A}						
C20:4n-6	Inner	0.26^{b}	0.34	0.23	0.029	0.080	0.023	0.779
	Outer	0.31^{a}						
C22:4n-6	Inner	0.17	0.19	0.11	0.023	0.092	0.189	0.063
	Outer	0.12						
Σ SFA	Inner	40.60^{a}	39.44	39.61	0.457	0.857	0.016	0.378
	Outer	38.45^{b}						
Σ MUFA	Inner	44.83	45.16	44.51	0.614	0.607	1.000	0.414
	Outer	44.83						
Σ PUFA n-6	Inner	13.56^{B}	14.30	14.76	0.264	0.400	0.002	0.709
	Outer	15.50^{A}						
Σ PUFA n-3	Inner	1.01^{B}	1.11	1.13	0.026	0.706	0.002	0.525
	Outer	1.22^{A}						
Σ PUFA	Inner	14.57^{B}	15.40	15.89	0.285	0.417	0.001	0.688
	Outer	16.72^{A}						

MSE = mean standard error; $^{A, B}$ = highly significant at $p < 0.01$; $^{a, b}$ = significant at $p < 0.05$.

Subcutaneous fat layers grow at different rates than changes in body weight (Camara et al., 1996; Hausman, 2018). At birth, the outer layer is the most abundant (early developing), then the inner layer develops further, becoming thicker (later developing; Fortin, 1986). In addition, the inner layer seems more dynamic than the outer layer (McEvoy et al., 2007). In agreement with the present study, Ayuso et al. (2020) hypothesized that the inner layer had higher *de novo* FA synthesis than the outer layer. In fact, C16:0 and SFA, which are also synthesized *in vivo* (Domaradzki et al., 2022), were higher in the inner layer. The increased synthesis of FA might have diluted and, thus, reduced in percentage terms, the concentrations of C18:2n-6 and C18:3n-3, which have only dietary origin. This makes the outer layer better from a nutritional point of view but technologically worse because it is more tender and prone to oxidation/rancidity. This different FA composition leads to different fluidity of fat layers, which can be explained as an adaptation of pigs to environmental temperature (Monziols et al., 2007). Hence, the outer layer would have a higher percentage of UFAs, which at colder outdoor temperatures, would be able to maintain a greater fluidity compared to saturated fats. From the point of view of thermoregulation and energy metabolism, the outer layer plays a role in thermal insulation, while the inner layer, as mentioned above, seems to be more active in storing and mobilizing energy reserves (Minelli et al., 2016). Regarding the acidic composition of lard from Mangalica pigs in the present study, it was observed that monosaturated fatty acids (MUFAs) were the most represented (44.83% of total FAs, on average), followed by SFA (39.53% of total FAs, on average) and PUFA (15.65% of total FAs, on average).

As with subcutaneous fat, the FA composition of the loin was not significantly affected by sex (more details in Table S2). Jaturasitha et al. (2006) failed to find clear differences even when comparing females and barrows, suggesting that the effect of hormones on the FA profile was very limited. The most abundant FA was C18:1n-9 at 41.4%. The observed SFA and MUFA values were 39.9% and 52.6%, respectively, which are nutritionally advantageous values for humans compared to other breeds (Parunović et al., 2013).

Fig. 1 provides an overall description of the FA profile of the inner and outer fat layer and loin. Loin samples were well separated from subcutaneous fat samples on the first principal component (PC), with 56% of the variance explained, while the second PA explained 10% of the variance, separated into inner and outer fat. Along the first PC, loin was positively associated with MUFAs. Along the second PC, the inner layer correlated with SFA, while the outer layer correlated with UFAs. The differences between the outer and inner layers were previously discussed. In agreement with the present study, Renaville et al. (2018) found a higher level of MUFAs, particularly C18:1 and C16:1, in the loin compared to subcutaneous fat. Poklukar et al. (2020) reported that, in general, adipose tissue is the most important tissue for lipid synthesis. However, Bessa et al. (2013) explained that the activity of enzymes involved in lipogenesis can be tissue-specific. It is well known that stearoyl-CoA desaturase (SCD) mainly converts C16:0 to C16:1 and C18:0 to C18:1. Considering that the indices for C16 desaturase activity (iC16: (C16:1n-9)/(C16:1n-9+C16:0); Faria et al., 2015) and C18 desaturase activity (iC18: (C18:1n-9)/(C18:1n-9+C18:0); Faria et al., 2015) were highly significantly ($p < 0.01$) greater in the loin than the subcutaneous fat (iC18: 0.77 versus 0.71, respectively, for loin and subcutaneous fat) and iC16: 0.15 versus 0.09, for loin and subcutaneous fat, respectively, highly significant at $p < 0.01$; data not reported in Tables), it could be speculated that SCD activity was higher in the loin.

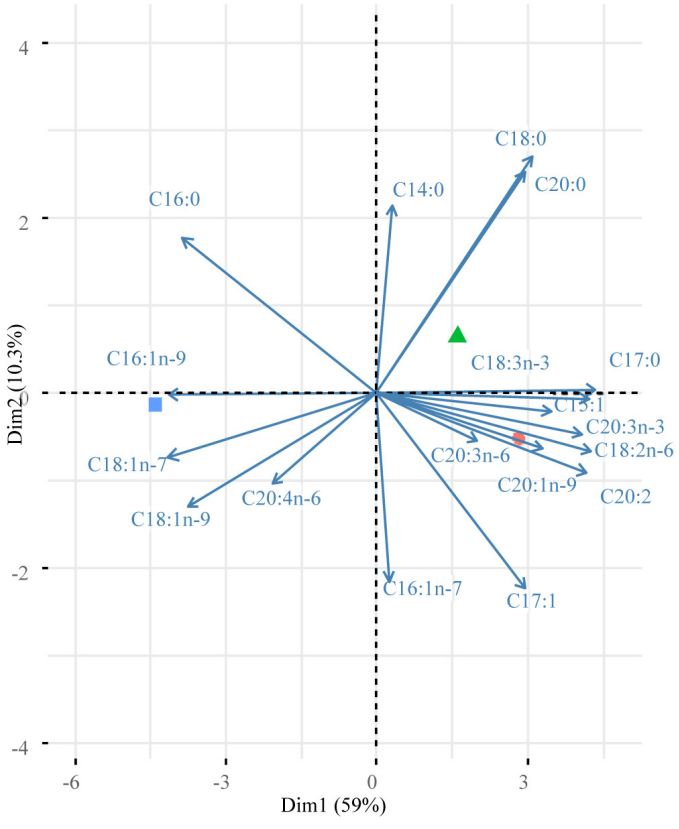

Fig. 1 Principal component analysis of fatty acid data for loin (blue squares) and inner layer (green triangles) and outer layer (red circles) of subcutaneous fat

Conclusions

Sex did not affect the carcass, loin or lard characteristics. Interesting differences were found between the inner and outer layers of subcutaneous fat. In particular, the inner layer was brighter and had a more saturated FA profile than the outer layer. The results of the present study indicated that the Mangalica breed could be effectively reared for heavy pig production in an outdoor breeding system.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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