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Article

Quality characteristics of the *Musculus longissimus dorsi* from Pecora dell'Amiata reared in Tuscany

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Abstract

The trial was performed with ewes and lambs deriving from the local breed Pecora dell'Amiata. In this work, the Musculus longissimus dorsi (M. longissimus thoracis + lumborum) physical-chemical and nutritional characteristics of 23 ewes and 20 lambs were compared. The ewes of the trial were over 7 years old while the lambs were on average 80 days old. Ewe meat has shown lower drip loss (4.14 vs 2.71%) and lightness (L 38.6 vs 45.3) values, and higher PH (6.15±0.07), shear force (8.4 vs 2.31 kg), fat content (5.9 vs 2.0%). The lamb meat lipids had higher Polyunsaturated Fatty Acid (PUFA) content (14.58 vs 9.25%) and higher PUFA/Saturated Fatty Acids (SFA) ratio (0.31 vs 0.20). The Principal Component Analysis (PCA) identified two distinct groups regarding ewe and lamb meat respectively for the fatty acids composition and the Health Indices. Ewe meat showed dietetic and nutritional characteristics similar to that of lamb meat. These characteristics may allow in the future, to the ewe meat valorisation, now not appreciated by Tuscan and Italian market.*

KEYWORDS

Fatty acids, lambs, ewes, meat quality, PCA.

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1 Introduction

1.1 Introduction

Pecora dell'Amiata is an autochthonous Tuscan sheep breed, registered in the Regional population register of the autochthonous endangered sheep and goat breeds (D.M. 17444/2014), having meat and milk as main productions (Giorgetti *et al.*, 2012; ASSONAPA, 2016). This breed may have an important role in ovine meat local market that valorises the regional supply chain. The ovine Tuscan market follows the Italian trend consumption; the sheep meat consumption occurs in particular in Easter and in Christmas time. The most consumed sheep meat is the light lamb meat (enough 30 days of age) from suckling lambs. This trend, constant during the years (ISTAT, 2010; Tocci *et al.*, 2015), is in contrast with the European continental countries sheep meat consumption (Kegalj *et al.*, 2011). In the last years, the meat production and consumption decreased in Italy, but the ewe meat consumption has been slowly increased, because of the spread of typical regional food ("arrosticini", salami, ham sheep ecc…), and the new market needs: the west-northern African, and the near Eastern immigrated populations appreciate this product (Tocci *et al.*, 2015). In this study, the qualitative characteristics of ewe and lamb *Musculus longissimus dorsi* of Pecora dell'Amiata were considered.

2 Materials and Methods

2.1 Animals

This work dealt with the post mortem results of 23 over 7 years old (min. 8, max. 10. mean 9 years) ewes and 20 lambs slaughtered at 80 days (min. 70, max. 90, mean 80 days). The ewes were reared with a pasture-based semi-extensive system, with a supplementation of hay ad libitum and 400 gr of barley during the night housing. The lambs were raised with their dams on the pasture.

Before the slaughtering all animals were weighed. Ewes and lambs of this trial were slaughtered following the Council Regulation of 24 September 2009 on the protection of animals at the time of killing - animal welfare guidelines, which provide the head-only electrical as stunning method (European Council, 2009). The ewe carcasses were weighed, and valuated for conformation and fat covering following the UE grid (COMMISSION REGULATION (EC) 2008). The lamb carcasses were weighed, measured, and valuated following the slaughter procedures of ASPA (1991); carcasses were classified, according to the EU Mediterranean grid, for carcass color and fatness score by experienced evaluators (EEC, 1993).

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2.2 Laboratory analysis:

In order to evaluate the physical-chemical and nutritional characteristics of the meat, four days after slaughtering, samples from the *Musculus longissimus dorsi* were collected (Rizzi *et al.*, 2002). The carcasses were stored at 4 °C.

On these samples, PH was measured in triplicate, through Mettler Toledo DevenGo SG2™ PH-meter (Novate Milanese, Milano, Italy) equipped with an Inlab puncture electrode (Mettler-Toldedo, Ltd). The mean value was considered.

The water holding capacity (WHC) was determined through the Filter paper press Grau and Hamm method (1957), the drip loss, and the cooking loss. The Filter paper press method is expressed as the ratio M/T, where M is the area (cm^2) of a cuboidal sample of 300 ± 5 mg kept for four minutes under a pressure of 50 kg/cm^2, and T is the total wetted area of filter (cm^2) (Destefanis et al., 1991; Hofmann et al., 1982). The drip loss was performed on cubic samples of 30 grams kept at 4 °C for 48 h in a plastic container with double bottom. The cooking loss was carried out on parallelepiped samples of about 40 grams of weight kept in oven at 180 °C to an internal temperature of 75 ° C (Poli et al., 1994).

The meat colour was determined on three different homogeneous areas of each samples, which were kept 1 hour at room temperature; the meam value was considered. PH was measured through Minolta Chromameter CR 200, calibrated against a standard white tile in the CIE L, a*, b* system, which measures the values of Lightness (L*), redness (a*), yellowness (b*), Chroma (colour saturation – (a2+ b2)1/2) and Hue angle (arctan b/a) (Renerre, 1982; ASPA, 1996).

The texture analyses (Aussanasuwannakul *et al.*, 2010) were carried out in raw and in oven cooked (1 cm x 1 cm) samples using a Zwick Roell® 109 texturometer (Ulm, Germany) with Text Expert II software, equipped with a 1 kN load cell. The Warner-Bratzler shear test (WB-shear force) consisted of a 3 mm thick steel blade which had a 73° V cut into it. The cut was perpendicular to the muscle fibre direction. The samples were placed on the table, under the V of the blade, and was cut through as the blade moved with a constant speed through the slit of the table (crosshead speed of 30 mm/min). The resistance of the samples to shearing was recorded every 0.01 seconds and plotted by a computer in a force deformation. Maximum shear force, defined as maximum resistance of the sample to shearing (Veland and Torrisen, 1999) was determined. Two raw and two cooked cores from each sample were submitted to WB-Shear force; the mean value of both measures was considered.

The Chemical analyses were carried out on each sample of *Musculus longissimus dorsi* determining dry matter, ether extract, crude protein and ash (AOAC, 1990). The samples were analysed for total lipid concentration by gravimetric determination of total lipid extract according to Folch *et al.* (1957). The tissue was homogenized with chloroform/methanol (2/1) to a final volume 20 times the volume of the tissue sample (1 g in 20 ml of solvent mixture). After dispersion, the whole mixture is agitated during 15-20 minutes in an orbital shaker at room temperature. The homogenate was either filtrated (funnel with a folded filter paper) to recover the liquid phase. The solvent was washed with 0.2 volume (4 ml for 20 ml) of water or better 0.9% NaCl solution. After vortexing some seconds, the mixture was centrifuged at low speed (2000 rpm) to separate the two phases. After centrifugation and siphoning of the upper phase, the lower chloroform phase containing lipids was evaporated under vacuum in a rotary evaporator or under a nitrogen stream if the volume is under 2-3 ml (Folch *et al.*, 1957). The

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samples were also analysed for quantitative fatty acid composition of total lipids by gas chromatographic separation of methyl esters, comprising C19:0 as internal standard, on capillary column oven temperature ranging from 164°C and 200°C with 3°C/min heat increment.

The following health indices were also calculated: MUFA (Monounsaturated Fatty Acids)/SFA, PUFA/SFA, ω6/ω3 PUFA, EPA (C 22:5 ω3)/DHA (C22:6 ω3) ratio.

2.3 Statistical analysis:

Data were submitted to one way ANOVA through the means squares method, using JMP 10 statistical software (SAS Institute Inch 2013), and considering as fixed factor the category (ewe meat and lamb meat). A PCA was performed on single fatty acids and on fatty acid types; when many measures are used to assess meat quality and they are correlated, they can be replaced by fewer measures without a significant loss of information (Karlsson, 1992). A Bartlett test was performed: the Bartlett's test compares the observed correlation matrix to the identity matrix. This test checks if there is a certain redundancy between the variables that we can summarize with a few number of factors. If the variables are perfectly correlated, only one factor is sufficient. If they are orthogonal, we need as many factors as variables. The Kaiser test was also performed: this test rotates only the factors with eigenvalues-greater-than-one (Kaiser, 1960). A VARIMAX rotation was performed in order to maximize the factors variance (Davis, 2002). The reduction in dimensionality is thus achieved by PCA might be useful in visual interpretation of the data represented by two-dimensional graphics (Kopuzlu *et al.*, 2011). Accordingly, a score plots and loading plots for sheep meat categories was performed. A correlation analysis between single fatty acids and between types of fatty acids was also performed.

3 Results

The live weight of ewes was 46.45±9.69 kg while that of lambs was 21.22 ± 1.13 kg. The carcass weight was 22.61 ± 0.74 kg and 10.96 ± 0.65 kg for ewes and lambs respectively, while the carcass conformation was R and C1. The fat score for the carcass ewes was 3. The chemical characteristics of grass and hay of the ewes' diet are shown in table 1. The crude protein content was 15.4% and 8.5 % respectively for grass and hay, while the fibre content was 25.8% and 34.0%.

Table 1: Chemical composition of the component ewes diet (%/DM)

		Dry matter	Crude protein	Crude Fiber
Grass	%	20.0	15.4	25.8
Hay	%	88.5	8.5	34.0
Barley	%	89.9	11.2	6.1

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The physical characteristics of the ewe and lamb meat (table 2) have shown that the latest had lower PH, cooking loss and drip loss. The free water, physiologically bonded to the muscle fibres, was similar between meat types. Lamb meat was tenderer, more brilliant, and more saturated in colour than the ewe meat. Relatively to the chemical analysis (table 2), the lamb meat had higher crude protein content, and lower fat content. In table 3 the fatty acids were also shown: among the SFA, C12:0, C14:0, C15:0 and C16:0 contents were higher in the lamb meat, C17:0 and C20:0 contents were comparable between meat types, and C18:0 content (Stearic acid) was higher in the ewe meat. Among the MUFA, C14:1 ω 5 and C16:1 ω7 contents were higher in the lamb meat, while C20:1 ω9 content (Gadoleic acid) was higher in the ewe meat (table 3). The ω6 PUFA, among which the Linoleic acid, were higher in the lamb meat. C18:3 ω3 content (α-Linolenic acid-ALA) was comparable between the meats, while Eicosapentaenoic acid (EPA), and Docosahexaenoic acid (DHA) have shown higher content in ewe meat. The Health Indices indicated a better PUFA/SFA ratio in the lamb meat, because of the higher PUFA content. EPA/DHA was also favourable (lower values) on lamb meat.

Table 2: Ewe and lamb Musculus longissimus dorsi physical and chemical characteristics (mean±SEM)

		EWE	LAMB	Sign.
PH		6.15±0.07	5.61±0.05	***
Water holding capacity				
Cooking loss	%	34.37±1.81	27.63±1.46	***
Drip loss	%	4.14±0.40	2.74±0.32	***
M/T		0.62±0.01	0.58±0.01	n.s.
Tenderness				
Shear force on raw meat	N	82.36±3.87	23.10±1.80	***
Shear force on cooked meat in oven	N	79.93±4.20	30.91±2.46	***
Color				
Lightness	L*	38.63±0.69	45.34±0.72	***
Redness	a*	19.33±0.57	20.84±0.59	n.s.
Yellowness	b*	6.20±0.63	7.84±0.66	n.s.
Chroma	C*	20.30±0.64	22.50±0.67	**
Hue angle	h* (°)	0.30±0.02	0.35±0.02	n.s.
Chemical characteristics				
Dry matter (D.M.)	%	25.46±0.59	24.94±0.71	n.s.
Moisture	%	74.53±0.59	75.05±0.71	n.s.
Ash	%	1.20±0.06	1.29±0.07	n.s.
Crude protein	%	19.04±0.40	21.25±0.48	***
Fat	%	5.12±0.43	2.09±0.51	***

1 n.s.= not significant; ** P≤0.05; *** P≤0.00

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Table 3: Ewe and lamb Musculus longissimus dorsi: % of fatty acids on total fatty acids (mean±SEM)

		EWE	LAMB	Sign.
C12:0	%	0.12±0.05	0.60±0.05	***
C14:0	%	2.26±0.32	5.91±0.30	***
C14:1 ω5	%	0.06±0.01	0.21±0.01	***
C15:0 ai	%	0.20±0.01	0.26±0.01	**
C15:0	%	0.51±0.04	0.74±0.03	***
C16:0 iso	%	0.19±0.01	0.23±0.09	***
C16:0	%	22.55±0.55	24.23±0.50	**
C16:1 ω7	%	1.41±0.08	1.97±0.07	***
C17:0 ai	%	0.61±0.02	0.61±0.2	n.s.
C17:0	%	1.15±0.04	1.12±0.03	n.s.
C17:1	%	1.00±0.09	1.15±0.09	n.s.
C18:0	%	17.57±0.60	13.40±0.54	***
C18:1 ω9	%	33.62±1.16	32.80±1.05	n.s.
C18:2 ω6 cis	%	5.48±0.37	7.81±0.34	***
C18:3 ω3	%	1.58±0.10	1.63±0.09	n.s.
C20:0	%	0.11±0.01	0.10±0.01	n.s.
C20:1 ω7	%	0.007±0.006	0.01±0.05	n.s.
C20:1 ω9	%	0.21±0.01	0.10±0.01	***
C20:2 ω6	%	0.13±0.03	0.24±0.03	**
C20:3 ω6	%	0.10±0.01	0.18±0.01	***
C20:4 ω6	%	1.12±0.18	2.93±0.17	***
C20:5 ω3	%	0.40±0.07	0.95±0.06	***
C22:0	%	0.01±0.001	0.04±0.009	n.s.
C22:5 ω3	%	0.42±0.05	0.83±0.04	***
C22:6 ω3	%	0.12±0.04	0.50±0.04	***
SFA	%	45.49±0.78	47.47±0.71	n.s.
MUFA	%	36.31±1.08	36.27±0.98	n.s.
PUFA	%	9.25±0.71	14.58±0.64	***
ω3	%	2.40±0.20	3.41±0.18	***
ω6	%	6.84±0.55	11.17±0.50	***
MUFA/SFA		0.80±0.33	0.77±0.03	n.s.
PUFA/SFA		0.20±0.01	0.31±0.01	***
ω6/ω3		3.12±0.17	3.32±0.15	n.s.
EPA/DHA		3.90±0.26	2.07±0.31	***

n.s.= not significant; ** = P≤0.05; *** = P≤0.001

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On the fatty acids and on the Health Indices PCA of fatty acids was carried out. The purpose of PCA was to individuate the presence of fatty acids composition in the ewe meat and in lamb meat, through the axis deriving from the correlation matrix, and extracting the Eigenvalues with different factorial load. The PCA has shown 5 main factors with eigenvalue higher than 1 which explained almost 82% of the variability (table 4). PC1 only explained 35.67% and the PC2 20.69%. The score plot and the loading plot of the fatty acids composition for sheep meat types (Figures 1 and 1a) have shown in the PC1 two distinct groups that identified the ewe and the lamb meat.

Table 4: Fatty acids percentage in ewe and lamb meat: Eigenvalue, cumulative percentage of variance and Bartlett test

Number	Eigenvalue	Percentage	Cumulative percentage	Chi-sq.	DF	Sign.
1	9.63	35.67	35.67	1676.65	346.91	***
2	5.58	20.69	56.35	1319.87	338.30	***
3	3.46	12.82	69.18	1039.65	322.30	***
4	1.90	7.03	76.21	816.68	302.65	***
5	1.41	5.24	81.46	680.99	280.83	***

*** = P<.0001

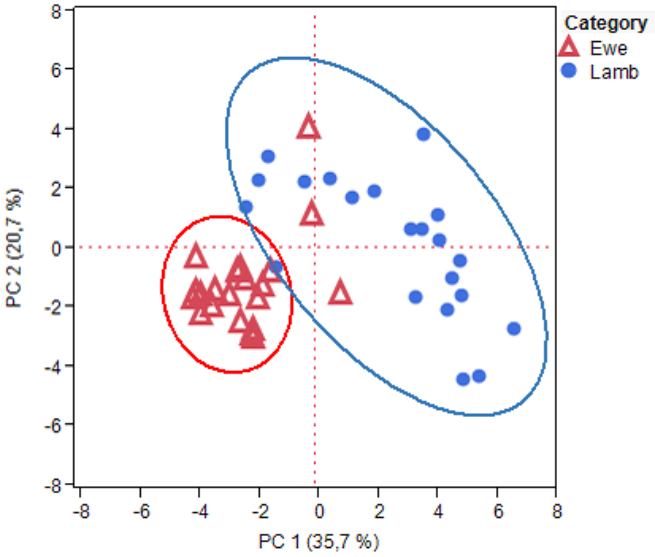

Figure 1. Score plot of fatty acids composition for sheep meat categories

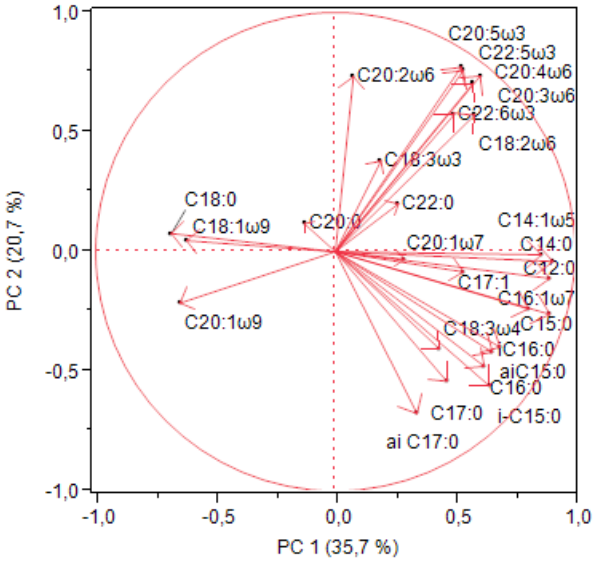

Figure 1a. Loading plot of fatty acids composition for sheep meat categories

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Table 5: Correlations between fatty acids

	C12:0	C14:0	C14: 1ω5	i-C15:0	aiC 15:0	C15:0	iC16:0	C16:0	C16: 1 ω7	ai C17:0	C17:0	C17:1	C18:0	C18: 1ω9	C18: 2ω6	C18: 3 ω4	C18: 3ω3	C20:0	C20: 1ω9	C20: 1-n7	C20: 2ω6	C20: 3ω6	C20: 4ω6	C20: 5ω3	C22:0	C22: 5ω3	C22: 6 ω3
C12:0	1																										
C14:0	0.95	1																									
C14:1- ω5	0.84	0.92	1																								
i-C15:0	0.57	0.51	0.41	1																							
aiC15:0	0.70	0.58	0.42	0.85	1																						
C15:0	0.88	0.80	0.7	0.78	0.89	1																					
iC16:0	0.57	0.55	0.47	0.73	0.76	0.75	1																				
C16:0	0.71	0.74	0.63	0.58	0.47	0.62	0.37	1																			
C16:1- ω7	0.73	0.82	0.88	0.50	0.42	0.66	0.55	0.69	1																		
ai C17:0				0.63	0.49	0.48	0.49	0.42	0.39	1																	
C17:0				0.63	0.57	0.59	0.54	0.38		077	1																
C17:1			0.35	0.42	0.39	0.43	0.47		0.52		0.42	1															
C18:0	-0.67	-0.76	-0.86			-0.49		-0.62	-0.85				1														
C18:1-ω9	-0.46	-0.40		-0.63	-0.68	-0.62	-0.42	-0.36			-0.46	-0.56		1													
C18:2-ω6		0.36	-0.39			0.36						0.57		-0.48	1												
C18:3-n4				0.56	0.41	0.44	0.46			0.45	0.60	0.43		-0.44		1											
C18:3-ω3														-0.52	0.42		1										
C20:0								-0.38					0.45				0.36	1									
C20:1-ω9	-0.59	-0.67	-0.66			-0.45		-0.46	-0.49				0.60						1								
C20:1-n7																			-0.44	1							
C20:2-ω6										-0.37											1						
C20:3-ω6	0.35	0.39	0.41									0.41		-0.50	0.83		0.43		-0.43		0.49	1					
C20:4-ω6	0.38	0.45	0.51										-0.40		0.84		0.36		-0.55		0.54	0.90	1				
C20:5-ω3		0.36	0.42											-0.36	0.77		0.52		-0.47		0.49	0.88	0.92	1			
C22:0																			-0.35	0.50	0.38				1		
C22:5-ω3		0.37	0.35											-0.39	0.75		0.55		-0.50		0.60	0.84	0.89	0.92		1	
C22:6ω3	0.62	0.59	0.46			0.40									0.50						0.57	0.53	0.66	0.61	0.46	0.57	1

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The Varimax rotation has shown as 14 of 27 considered fatty acids represented the factor 1. The PC1 has shown as significant values the majority of SFA, while the PC2 has been identified in the PUFA; MUFA were equally distributed between PC1 and PC2. A great number of positive correlations between fatty acids were found (table 5). Most of SFA characterized the lamb meat, while C18:0, C18:1 ω9, having negative correlations (table 5), identified the ewe meat.

The PCA analysis was also performed for the fatty acids types and for the Health Indices. In this case three Eigenvalues higher than 1, explaining enough 90% of the cumulative variability, were observed. PC1 explained almost 47.75%, while PC2 27.41% (table 6). The score plot and the loading plot of the fatty acids types and Health Indices for ewe and lamb meat (figure 2 and 2a) have shown as both meat types were distinguished. The Varimax rotation for the fatty acids types has shown as significant values in PC1 the PUFA , both ω6 and ω3, and the PUFA/SFA ratio; MUFA, having negative correlation, showed lower value. PC2 identified for the SFA, for the MUFA and for the MUFA/SFA ratio. Higher correlations were shown in mono and PUFA, while the less correlated Health Index was ω6/ω3 that had negative correlation with PUFA ω3 (table 7). MUFA have shown the highest number of negative correlations. The PUFA types and the PUFA/SFA ratio identified in particular the lamb meat, while SFA, MUFA, and MUFA/SFA ratio, having almost always negative correlations, identified for the ewe meat.

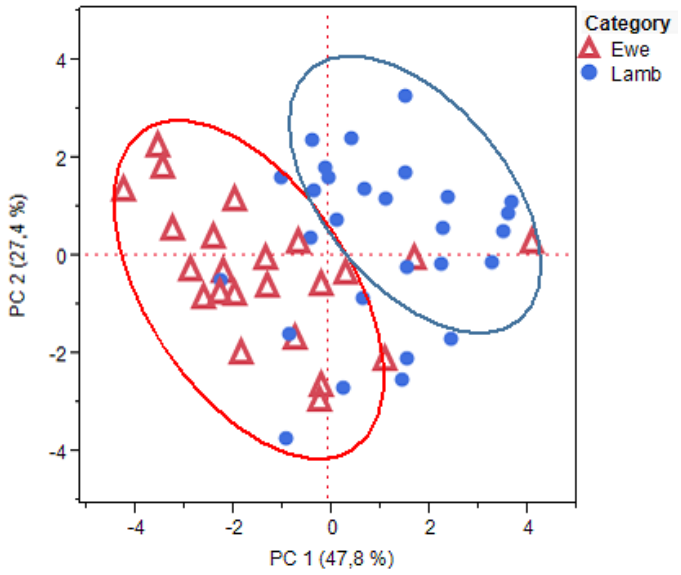

Figure 2. Score plot of the fatty acids types and Health Indices for ewe and lamb meat

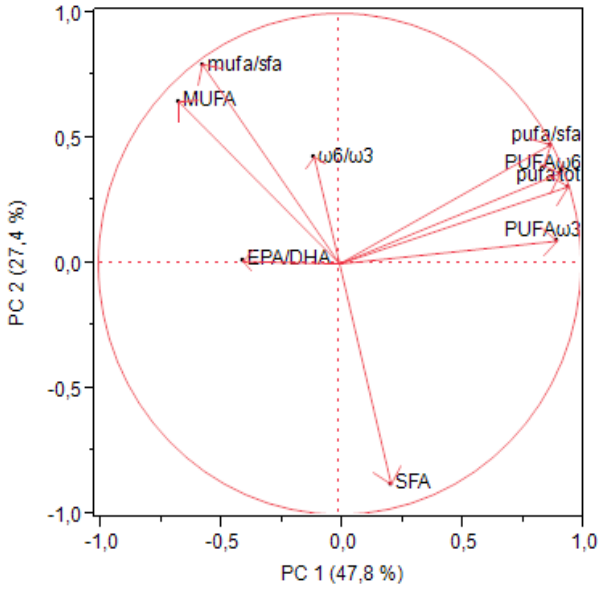

Figure 2a. Loading plot of the fatty acids types and Health Indices for ewe and lamb meat

Table 6. Fatty acid types and healthy indices in ewe and lamb meat: eigenvalue, cumulative percentage of variance and Bartlett test

Number	Eigenvalue	Percentage	Cumulative percentage	Chi-sq.	DF	P
1	4.30	47.75	47.75	1404.66	35.82	> 0.01
2	2.47	27.41	75.17	1254.91	34.36	> 0.01
3	1.27	14.13	89.30	1106.86	29.51	> 0.01

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Table 7. Correlation between Fatty acid Types and Health Indices

	SFA	MUFA	PUFA-ω3	PUFA-ω6	Tot Pufa	mufa /sfa	pufa /sfa	ω6 /ω3	EPA /DHA
SFA	1								
MUFA	-0.62	1							
PUFAω3		-0.49	1						
PUFAω6		-0.40	0.79	1					
pufa tot		-0.43	0.88	0.99	1				
mufa/sfa	-0.81	0.96	-0.40			1			
pufa/sfa			0.84	0.97	0.98		1		
ω6/ω3			-0.40					1	
EPA/DHA				-0.37	-0.35				1

4 Discussion

Live weight, carcass weight and the carcass evaluation identified ewes and lambs belonging to Mediterranean ovine breeds. Chemical composition of grass and hay of the sheep diet was typical of the central areas of Tuscany. The Pecora dell'Amiata ewe meat has shown higher PH, lightness, redness, and chroma values, lower yellowness, and hue angle than the Sarda ewe meat (Mezzette *et al.*, 2005). If compared with the Merino ram meat (Hopkins and Toohey, 2006) the ewe meat of the trial has shown similar PH value, lesser tenderness and water holding capacity. If compared with the Istrian lamb meat (Piasentier *et al.*, 2002), the Pecora dell'Amiata lamb meat had higher cooking loss, lightness and redness, while the shear force was lower; the PH values were similar between breeds. If compared with the Bergamasca and Suffolk lamb meat (Sirtori *et al.*, 2009) the lamb meat of the trial had lower cooking loss and higher chroma and Hue angle.

Relatively to the chemical composition, the high crude protein and low fat content in lamb meat have met the normal physiology of the animal growth (Russo *et al.*, 2003; Franci and Gualtieri, 1988).

The chemical composition of the ewe meat of this study was similar to that of the Santa Ines ewes, having the same carcass weight (Costantino *et al.*, 2014). If compared with the Istrian lamb meat (Piasentier *et al.*, 2002) the Pecora dell'Amiata lamb meat had higher crude protein and ash, lower fat content, while the dry matter percentage was similar. The lamb meat of the trial has shown lower crude protein content than the Bergamasca and Suffolk lamb meat (Sirtori *et al.*, 2009).

The Pecora dell'Amiata ewe meat and the Sarda ewe meat (Santercole *et al.*, 2007), had similar SFA, PUFA ω3 and ω6 content, while the MUFA content was lower in the meat of the study. If compared with the Istrian lamb meat (Piasentier *et al.*, 2002) the Pecora dell'Amiata lamb meat had lower PUFA ω6 content, while if compared with the Suffolk and Bergamasca lamb meat (Sirtori *et al.*, 2009), had higher SFA and PUFA ω3 percentage. The lamb meat of

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the trial has shown higher PUFA and MUFA contents than the meat of Santa Ines and its crosses lamb meat (Costa *et al.*, 2015).

If compared with the Merino ram meat (Greeff, 2007) the Pecora dell'Amiata ewe meat had lower C18:0 and C20:1 contents, while if compared with the Sarda ewe meat (Santercole *et al.*, 2007) had higher C18:0 content, and similar C22:5 ω3 and C22:6 ω3 contents. If compared with the Suffolk and Bergamasca lamb meat (Sirtori *et al.*, 2009) the lamb meat of this study has shown a lower C18:0, C18:1 ω9 and C18:2 ω6 cis contents, and higher C20:5 ω3 (EPA) content. The lamb meat of the trial has shown higher C22:5 ω3 and C22:6 ω3 contents than the meat deriving from Romanov cross lambs (Kuchtík *et al.*, 2012).

Relatively to the Healthy Indices, some authors recommend a ratio of 1:1:1 in the diet for SFA:MUFA:PUFA (Hayes 2002). Western diets are poor in ω3 fatty acids and rich in ω6 fatty acids. A lower ratio of ω6/ ω3 fatty acids allows reducing the risk of many chronic diseases typical of Western countries (Simopoulus, 2008). Simopoulos and Cleland (2003) claim that the ideal ω6/ω3 is 4:1 for brain-mediated functions. Some authors found that a similar 60/40 ratio of EPA/DHA eased depression somewhat in people with depression who didn't have anxiety disorders (Sarris, 2012).

Both meat types of this trial were characterised by a good ω6/ω3 ratio (3.12 and 3.32); in western countries diets this ratio is 15-16:1. Very important for this Index are the Linoleic Acid (LA) (ω6) and the Linolenic Acid (ALA) (ω3), which may compete with each other, because metabolised by the same enzyme, the Δ6-desaturase. This issue is important for the human health, because an excess of LA in the diet could reduce the Δ6-desaturase available for the ALA metabolism, with consequent risk of cardiac diseases increase (Stanley *et al.*, 2007). The Pecora dell'Amiata ewe meat has shown a favourable ω6/ω3 ratio if compared with Simopoulos parameters (2008), and slightly higher of that of Sarda ewe meat (Santercole *et al.*, 2007), while EPA/DHA ratio was similar between meats. If compared with the Istrian lamb meat (Piasentier et al., 2002) the Pecora dell'Amiata lamb meat had a slightly lower ω3/ω6 ratio, while if compared with the meat of Santa Ines lamb (Costa *et al.*, 2015), had a lower MUFA/SFA ratio and a higher PUFA/SFA ratio. EPA/DHA ratio was lower than that of Romanov crosses lamb meat (Kuchtík *et al.*, 2012).

The PCA highlighted as the ewe meat was characterized by C18:0, while the total PUFA and total SFA characterized the lamb meat. C18:0 characterized also the intramuscular fat deriving from the Faroese ewes (Jónsdóttir *et al.*, 2001). As in the case of the Faroese lamb meat, the higher SFA content (C12:0 and C14:0) derived from milk (Jónsdóttir *et al.*, 2001). Also in bovines and in goats, younger animals showed higher C12:0 and C14:0 content (Bednárová *et al.*, 2013; Beserra *et al.*, 2004).

5 Conclusion

Both ovine meat categories of this study have shown good dietetic characteristics with optimal Health Indices. The lamb meat has shown a higher PUFA content, both ω3 and ω6, who determined a better PUFA/SFA ratio, and both meat typologies had favourable ω6/ω3 ratio. The PCA showed two different groups: lamb meat had higher saturated fatty acids that are derived from milk, and ewe meat was characterized by C18:0. Lamb and ewe meat of

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Pecora dell'Amiata breed can be valorised in the local market. Considering the dietetic and nutritional meat characteristics of the ewe meat, not so different from the lamb meat characteristics, it seems possible to valorise this product, now not required by the Tuscan and Italian market.

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