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Carcass, meat and fat quality in Italian Merino derived lambs obtained with "organic" farming systems

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SUMMARY – The quality of carcass, meat and intramuscular fat was evaluated in thirty-two, 75 day-old, Italian Merino derived lambs produced using a certified organic farming system. At the same time 16 lambs from the same farm were weaned at 40 days of age and reared traditionally with hay+concentrate until 75 days and then slaughtered. Carcasses were classified with the SEUROP and bis-grid EU systems. Dressing percentage, *Longissimus dorsi* physical and chemical characteristics and fatty acid composition of intramuscular fat were determined. The results differed between "organic" and "traditional" lambs in both carcass, meat and fat quality.

Key words: Organic, Italian Merino Derived sheep, carcass, meat, quality.

RESUME – *"Qualité de la carcasse, de la viande et du gras chez des agneaux dérivés de Mérinos Italiennes obtenus selon un système d'élevage biologique". Ce travail décrit l'impact que peuvent avoir les systèmes biologiques de production ovine sur la qualité des carcasses et de la viande d'agneaux dérivées des Mérinos Italienne de 75 jours. On a utilisé 32 agneaux obtenus avec un système biologique certifié, élevés sous la mère jusqu'à 75 jours. Dans le même temps 16 agneaux ont été sevrés à 40 jours et élevés jusqu'à 75, avec un système traditionnel foin/concentré. A l'abattage on a contrôlé le poids, le rendement et le classement des carcasses en accord avec la grille SEUROP et bis UE. Sur le muscle* Longissimus dorsi *on a relevé les caractéristiques physiques et chimiques de la viande et du gras. Les résultats montrent de très intéressantes différences entre la carcasse et la viande des agneaux "biologiques" et celle des "témoins".*

Mots-clés : *Biologique, race ovine dérivée de Mérinos Italienne, carcasses, viande, qualité.*

Introduction

The European Union (EU) has invested many resources to develop sustainable animal production systems. In Italy, meat type lambs are already reared with extensive farming methods, which imply low stocking rate, use of natural pasture and so on (Rubino *et al*., 1983). The recent scandals (BSE, dioxin, etc.) on the use of contaminated feed for animals, with severe consequences for human health, has instigated more restricted production programmes (organic) in order to eliminate further abuse.

Organic farming systems are a particular form of extensive production, which use no chemical products both on the crop and on the animals. There is also a little use of chemical products in routine veterinary use. Instead, building up of the natural immune system is promoted with natural methods (low stocking rate, high quality feeds, clean grazing strategies) and the use of alternative medicines (Daw, 1993). The producers have to pay attention to the welfare, physiology and behaviour of the animal (Daw, 1993) and protect the bio-diversity.

EU policies have placed great importance on organic livestock husbandry systems (Reg. No. 2092/91, 2078/92, "AGENDA 2000" and some recent EU proposals). It is believed that such methods are better for animal welfare and that the final products (meat, milk and eggs) are healthier for the consumers (Daw, 1993). However doubts (the effectiveness of veterinary remedies, feeding strategies, the reality of the controls and so) have been expressed about some of the new practices (Daw, 1993).

In Italy the ancient Merino Derived breeds, for example 'Sopravissana' and 'Gentile di Puglia', are in great difficulty because of the breakdown of the wool-market. Their re-conversion to a meat type breed by crossing with more profitable European meat breeds has greatly reduced the original population (Sarti, 1997). In order to better understand these recent developments, for the breed and the organic production system, a trial was carried out to evaluate carcass, meat and

fat quality of Italian Merino Derived (IMD) lambs produced using an organic farming system (Pinton, 1997).

Material and methods

The organic farm (a co-operative) was located near the Abruzzi National Park (Italy), at 500-800 m a.s.l. The flock was composed of 1,125 IMD sheep, very similar to the 'Sopravissana' breed (Sarti, 1997). The organic farm produces 60 to 70-day-old lambs which sell locally and in other organic markets. Flock breeding is managed to have lambs for sale during the Christmas, Easter and August holidays. After weaning, the sheep are milked for about 100 days (400 g milk/d per head) and the milk is processed, without pasteurization, into a smoked buttermilk curd and herb cheeses. Other organic products are salami of mixed meat (sheep-pork) and compost (Morbidini *et al*., 1999).

This study investigated carcass, meat and fat quality of organic system lambs, certified by the Italian Association of Organic Agriculture – AIAB (Pinton, 1997). The trial was carried out on 32 IMD lambs (16 males and 16 females) raised with mothers' milk and organic hay and concentrate. Lambs were slaughtered at 75 days of age (Organic). At the same time a second group of 16 lambs (8 males and 8 females) were transferred, after weaning at 50 days, from the organic farm to the experimental centre at the Department of Animal Science, University of Perugia, and fed a diet of hay/commercial concentrate (40%/60%) until 75 days of age and then slaughtered (Control) (Morbidini *et al.,* 1999).

Slaughtering was done according to ASPA (1991) recommendations and carcasses were classified with the SEUROP and bis-grid EU (Panella *et al.*, 1995) systems. Physical, such as drip loss, cooking loss, Warner-Blatzler Shear force on raw and cooked meat, Water Holding Capacity (ASPA, 1996) and chemical analyses (gross energy, crude protein, fat, ash, and the fatty acid composition of the intra-muscular fat) were performed (AOAC, 1985) on the *Longissimus dorsi* muscle. Statistical analyses were executed according to the following linear model: $y_{ijk} = M + T_i + S_j + e_{ijk}$, where: y_{ijk} = experimental data, M = overall mean, T_i = effect of lamb growing system ("Organic" *vs* "Control"), S_j = effect of sex (male *vs* female), e_{ijk} = experimental error. SAS procedures were used for the statistical analysis (SAS, 1989).

Results and discussion

Lambs fed conventionally (Control) for 25 days had an ADG of 135 g/d, and their fast body weight at slaughtering was higher than in the "Organic" lambs (Table 1). It is possible that an early weaning and transporting stress, especially associated with changes in diet and environment, caused a lower warm dressing percentage in "Control" carcasses (Sanudo *et al*., 1998). As expected, sex influenced fast body weight (Morbidini *et al.,* 1999).

Table 1. Body and carcass weight, carcass classification according to UE grading system

Trait	Production system		Sex		s.d.E.	Overall mean
	Organic	Control	Male	Female		
Fast body weight (kg)	18.19^{A}	21.09^{B}	20.57^{A}	18.71^{B}	2.40	–
Warm dressing (%)	51.66^{A}	48.90^{B}	49.86	50.70	4.58	–
"B" EU bis-grid (%)	69.7	22.2	52.3	66.7	–	59.5
"C" EU bis-grid (%)	30.3	66.7	42.9	33.3	–	38.1
SEUROP EU grid (%)	0	11.1	4.8	0	–	2.4
Clear pink meat colour (%)	96.9	75.0	91.7	87.5	–	89.6
Pink meat colour (%)	0	25.0	8.3	8.3	–	8.3
Other meat colour (%)	3.1	0	0	4.2	–	2.1
1st quality carcasses (%)	96.9	100	100	95.8	–	97.9
2nd quality carcasses (%)	3.1	0	0	4.2	–	2.1

^{A,B}Values in the same effect, with different capital letters differ for P<0.01.

Carcass classification according to EU grading systems showed that only 2.4% of the carcasses were graded according to the SEUROP grid (Table 1). About 60% of all the carcasses were graded "B", weighing from 7 to 10 kg (only 22.2% of "Control" lambs) and 38.1% from 10 to 13 kg ("C" weight class). About 98% of the carcasses evaluated according to bis-grid were of first quality. All carcasses had ideal fatness (class "2" or "3"). Meat colour was ideal in 97.9% of the carcasses, but "Organic" carcasses were less pink than those of "Control" (Morbidini *et al.*, 1999).

Table 2 shows that meat from "Control" carcasses had a higher gross energy value (Sarti *et al*., 1994), probably due to its higher amount of fat (Morbidini *et al*., 1999). "Control" carcasses had significantly higher drip and cooking losses, hard raw meat and more tender cooked meat than "Organic" meat. Sex influenced fat, which was higher in females ($P<0.01$), tenderness (lower only in raw meat of males – $P<0.05$) and cooking loss (higher in males – $P<0.05$).

Table 2. Physical and chemical characteristics of *Longissimus dorsi* muscle

Trait	Production system		Sex		s.d.E.
	Organic	Control	Male	Female	
Gross energy (MJ/kg DM)	22.72^{A}	23.52^{B}	23.03	23.86	0.39
Dry matter (DM) (%)	25.59	25.54	25.27	25.86	1.17
Crude protein (CP) (% wet)	22.25	22.34	22.10	22.48	0.85
Fat (% wet)	1.96	2.16	1.79^{A}	2.33^{B}	0.54
Ash (% wet)	1.25^{A}	1.04^{B}	1.17	1.13	0.19
Drip loss (%)	0.81^{A}	1.38^{B}	0.95	1.24	0.73
WBS† (force, kg/cm^2 on raw meat)	3.19^{a}	3.47^{b}	3.47^{a}	3.20^{b}	0.43
WHC†† (internal area/external area)	0.78	0.83	0.80	0.82	0.11
Cooking loss (%)	13.41^{A}	24.54^{B}	19.81^{a}	18.14^{b}	2.60
WBS† (force kg/cm^2 on cooked meat)	5.64^{A}	4.16^{B}	4.79	5.00	0.67
Soluble collagen (% CP)	0.06	0.06	0.06	0.06	0.02
Not soluble collagen (% CP)	0.29	0.29	0.28	0.30	0.04

†WBS: Warner Blatzler Shear.
††WHC: Water Holding Capacity.
^{A,B,a,b}Values in the same effect, with different capital or small letters differ for $P<0.01$ and $P<0.05$ respectively.

The fatty acid % of intra-muscular *Longissimus dorsi* showed, as expected, a dominance of saturated fatty acids (SFA) in total meat (no differences between type of lambs – Horcada *et al.*, 1998) and an important amount of monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids (Enser *et al*., 1998), with positive eating consequences (Solomon *et al*., 1990). Differences between lamb types were shown in C15:0 and C23:0 which were lower in muscle from "Organic" and in C14:1 n-6, C16:1, C18:3 n-3, C20:5 n-3, C22:6 n-3, in whole n-3 and n-6 which were significantly higher in "Organic" muscle. There were no differences in Atherogenic and Thrombogenic Indices, both important for indicating possible risk of cardiovascular diseases (Ulbright and Southgate, 1991). Males had less C16:0, C16:1, C18:2 and more C18:3 n-3, C20:5 n-3 and the n-3 than females (Table 3).

Conclusions

The preliminary evaluation of the value of lamb carcass and meat from organically produced lambs showed only a few of the possible positive implications connected to this practice. Slaughtering characteristics (high dressing percentages, good carcass quality) and more positive physical and chemical characteristics (tenderness, cooking loss, etc.) of organically grown lambs, indicate that the IMD breed is suitable for organic production. Many other questions linked with organic farming, such as veterinary, feeding, animal welfare problems, sensory meat quality and marketing need further investigation.

Table 3. Some fatty acids in intramuscular fat in *Longissimus dorsi* muscle (% of total fat)

Fatty acid	Production system		Sex		s.d.E.
	Organic	Control	Male	Female	
C12:0	1.13	0.78	0.97	0.94	0.47
C14:0	8.80	7.64	7.88	8.57	1.99
C15:0	0.67^{A}	0.56^{B}	0.62	0.62	0.12
C16:0	28.69	29.61	28.46^{A}	29.84^{B}	1.65
C18:0	11.97	12.69	12.62	12.03	2.35
C23:0	0.007^{A}	0.016^{B}	0.011	0.012	0.009
SFA†	53.10	53.13	52.38	53.85	3.31
C14:1 n-6	0.63^{A}	0.37^{B}	0.44	0.56	0.28
C16:1	3.20^{A}	2.59^{B}	2.64^{a}	3.15^{b}	0.73
C18:1 n-9	28.90	30.56	30.28	30.18	2.61
C20:1	0.19	0.21	0.20	0.21	0.06
MUFA††	33.93	33.73	33.56	34.09	2.58
C18:2	8.21	9.04	9.33^{A}	7.93^{B}	1.46
C18:3 n-6	0.21	0.20	0.21	0.20	0.03
C18:3 n-3	0.97^{A}	0.82^{B}	0.93^{a}	0.85^{b}	0.12
C18:4 n-3	0.55	0.43	0.48	0.49	0.16
C20:3 n-6	0.15	0.16	0.13	0.14	0.05
C20:4	1.88	1.73	1.97	1.64	0.63
C20:5 n-3	0.34^{A}	0.23^{B}	0.29^{a}	0.28^{b}	0.09
C22:5 n-3	0.31	0.29	0.32	0.27	0.11
C22:6 n-3	0.16^{A}	0.09^{B}	0.14	0.11	0.05
PUFA	12.95	13.15	14.03^{a}	12.07^{b}	2.23
n-3	2.34^{A}	1.86^{B}	2.18	2.02	0.34
n-6	1.15^{A}	0.88^{B}	0.99	1.04	0.25
SFA/UFA†††	1.15	1.14	1.11	1.18	0.16
A.I.††††	1.78	1.69	1.68	1.76	0.33
T.I.†††††	1.87	2.01	1.90	1.98	0.25

†SFA: Saturated Fatty Acids.
††MUFA: Monounsaturated Fatty Acids.
†††UFA: Unsaturated Fatty Acids.
††††A.I.: Atherogenic Index.
†††††T.I.: Thrombogenic Index
^{A,B,a,b}Values in the same effect, with different capital or small letters differ for $P<0.01$ and $P<0.05$ respectively.

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