

Meat quality of Italian Simmental young bulls as effected by the proportion of Montbeliarde crossing

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Summary

In order to provide an evaluation of the effect of the degree of inclusion of genes of Montbeliarde origin on carcass and meat traits of the Italian Simmental breed, 104 young bulls, belonging to five strains differing in the percentage of genes originating from Montbeliarde: 0% (traditional strain, 22 animals), 12.5 to 25% (21), 50% (22), 75% (23), and 87.5 to 100% (Montbeliarde strain, 16), were slaughtered at the age of 16-20 months, at homogeneous live weight. As the level of French ascendance increased the carcass conformation scores linearly decreased, while the carcass length increased. Among meat traits, those highly affected by genotype were insoluble collagen content and toughness, instrumentally measured, which both linearly increased with the frequency of Montbeliarde genes.

Riassunto

Influenza della proporzione di sangue Montbeliarde sulla qualità della carne di vitelloni di Pezzata Rossa Italiana. E' stata misurata su 104 vitelloni di 16-20 mesi appartenenti a 5 gruppi, differenziati per la frequenza dei geni di origine Montbeliarde: 0% (ceppo tradizionale, 22 animali), 12.5 - 25% (21 animali), 50% (22 animali), 75% (23 animali), e 87.5 - 100% (ceppo Montbeliarde, 16 animali). Con l'aumentare del grado di ascendenza Montbeliarde è linearmente diminuito il punteggio di conformazione della carcassa, la cui lunghezza è invece aumentata. Relativamente alla carne, i caratteri maggiormente influenzati dal genotipo sono stati il contenuto di collagene insolubile e la durezza, strumentalmente misurata, che sono entrambi aumentati con la frequenza di geni Montbeliarde nei vitelloni.

Introduction

Italian Simmental (IS) is the most common dual-purpose breed in Italy. At the end of 1999 87,733 bovines were registered in the national Herd book: approx. 45,000 dual-purpose cows and approx. 4,000 suckler cows. More than 80% of total amount is in the "Triveneto" Regions (Veneto, Friuli-Venezia Giulia and Trentino-Alto Adige), the remaining part is distributed in the other Regions, excluding Sardinia and Valle d'Aosta.

The breed Technical Commission has recently modified the selection index - Dual-Purpose Index (IDA) - with an improvement of meat component compared to milk component. In the actual IDA the attitude ratio is 1:2 - meat incidence 27% and milk incidence 53% - instead of 1:3 as in the modified IDA.

Milk quality is good, with an average composition of 3.90% fat and 3.40% protein (source: AIA, 2000). Milk is transformed into valuable cheeses such as Montasio. The calves are sold within the first week of birth to be reared in specialised centres for the production of either young bulls or veal calves.

In the '90s, when high amounts of capital were invested for the transformation from tie-standing to loose housing stable, with the consequent increase of the minimum number of animals per farm, the farmers strongly stated their will for the improvement of milk production, udder conformation and of milk flow rate.

The National Breeders' Association conceded a controlled introduction of the best Montbeliarde bulls, the French strain of Simmental breed (Besozzi, 1996). The presence of Montbeliarde cattle in French Giura dates back to approx. 300 years ago, when a group of Swiss Anabaptists escaped from religious persecution with their animals (Dominique, 1989; Spindler, 1989), and is nowadays the second most numerous in France. The Montbeliarde has been continuously improved, genetically,

for milk production, and from its milk famous French AOC cheeses, such as Comt , Emmenthal Grand Cru, Saint-Nectaire, Reblochon and others, are produced.

At present, the frequency of genes of Montbeliarde origin in the IS population is important, as proved by the Italian breeders' index: among the Rank90 bulls, 17 animals (out of 69) have >25% Montbeliarde genes (ANAPRI, 2002). Furthermore, two of the Italian bulls forming part of the best one-hundred European Simmental bulls, are 50% Montbeliarde.

This probably modified both milk and carcass-and-meat quality (Miksik et al., 1996; Verbic et al, 1998), in comparison with qualities recorded before the '90s, when the less milk-producing and better conformed Simmental Bavarian strain was strongly prevailing (Bonsembiante et al., 1988, El-Hakim et al., 1986; Gigli and Romiti, 1989; Hegedus and Burgstaller, 1985; Wyss, 1988).

The aim of the research is the evaluation of carcass and meat quality traits of IS young bulls, and their relationship with the degree of inclusion of genes of Montbeliarde origin.

Material and methods

Animals

The research was carried out on 104 young bulls of IS breed, belonging to five strains differing in the percentage of genes of Montbeliarde origin: 0% (traditional strain: ISt), 12.5 to 25% (IS25m), 50% (IS50m), 75% (IS75m), and 87.5 to 100% (Montbeliarde strain: ISm). The animals were chosen among the bulls subjected to performance test at the IS National Association Genetic Centre, reared on slatted floor multiple boxes and destined to slaughtering. The young bulls were slaughtered at the age of 16-20 months, at homogeneous live weight, as reported in table 1.

Table 1. Italian Simmental young bulls number and characteristics.

Strain	Genes of Montbeliarde origin	Animals (no.)	Age (days)		Live weight (kg)	
			mean	std.	mean	std.
ISt	0%	22	546	26.9	677	42.5
IS25m	24%	21	538	20.7	678	44.9
IS50m	50%	22	548	25.4	686	60.1
IS75m	75%	23	543	27.6	674	44.7
ISm	95%	16	555	40.6	663	45.4
mean	47%		545	28.1	676	47.7
total		104				

Measurements

Young bulls' live weight, somatic measures and morphological evaluation were recorded.

Carcass weight, measures, fatness and conformation (SEUROOP classification) had been recorded 24 hours after slaughtering (ASPA, 1991). Meat pH and colour (L*, a*, b*) were evaluated on m. *longissimus dorsi* samples.

Other sections of m. *longissimus dorsi* were used to provide:

- two meat samples that were quickly frozen under vacuum and stored at -20 C (samples no. 1 and 2);
- one meat sample that was aged under vacuum at 0-4 C for 7 days (sample no. 3).

The following analyses were carried out (ASPA, 1996):

- sample 1: water, protein, ether extract, and ash;
- sample 2: total and soluble collagen;
- sample 3: water loss (in water bath at 75 C) and shear force (Warner-Bratzler shearing device on Instron testing machine).

Statistical analysis

Data were subjected to analysis of variance or covariance using a one-way factorial design, in order to examine the effects of the strain, whose levels were compared by orthogonal polynomial contrasts, using the SPSS 7.5.21 package for Windows (SPSS Inc., Chicago, USA).

The comparison between the proportion of carcasses of various quality was carried out by a chi-square test of independence.

Results

The five young bulls strains showed similar daily gains (on average: 1250 g/d, table 2) and carcass weights, which averaged 383.5 kg (s.e. 30.32 kg), with a mean dressing percentage equal to 56.7% (s.e. 2.00 %).

Table 2. Average daily gain (g/d).

Strain	5 to 12 months	12 months to slaughter	5 months to slaughter
ISt	1370	1130	1260
IS25m	1320	1150	1240
IS50m	1320	1130	1230
IS75m	1350	1220	1290
ISm	1350	1100	1240
mean	1340	1150	1250
s.e.	132	196	111

The carcass conformation scores decreased linearly as the frequency of Montbeliarde genes increased (figure 1), while the fatness scores kept a steady-state leaning across the experimental groups (average score 2.6, on a five points scale).

The linear trend of the carcass length, estimated at a constant weight, showed an opposite slope in comparison to the conformation one, so that the less scored ISm strain bulls had the longest carcass (table 3).

Table 3. Carcass measurements (cm).

Strain	Carcass length	Depth of chest	Leg length	Minimum leg width	Maximum leg width
ISt	138.5	44.9	87.0	29.9	45.4
IS25m	138.2	44.3	86.5	29.1	45.4
IS50m	138.5	44.8	86.4	28.5	45.1
IS75m	139.1	44.8	86.9	29.2	44.0
ISm	140.9	44.8	85.8	28.8	45.0
mean	139.0	44.7	86.6	29.1	45.0
s.e.	2.71	1.81	1.97	1.97	1.86
Covariate	Carcass weight	Carcass length	Leg length		
Coefficient	0.095	0.080	0.303	0.312	0.141
Coefficient s.e.	0.0090	0.0463	0.0504	0.0872	0.0822
P linear contrast	0.01	ns	ns	ns	ns

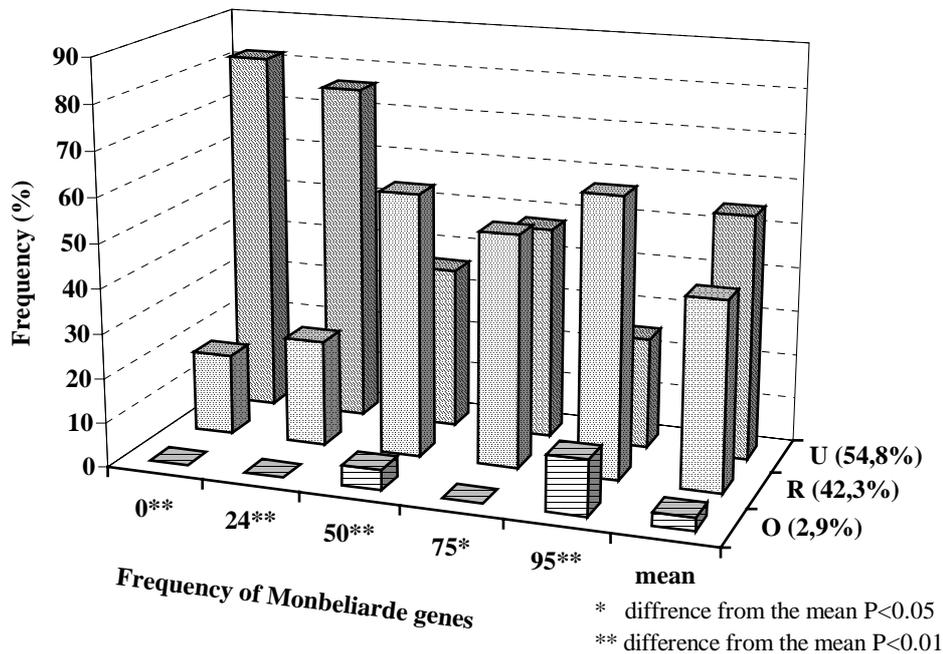


Figure 1. Carcass conformation scores.

The ultimate pH did not vary between strains and its values fell within the normal pH range accepted for commercial meats (table 4). Meat colour was slightly affected by genotype, showing a tendency to become progressively darker, a deeper red and yellow, with the increase of the proportion of genes of Montbeliarde origin.

Table 4. pH, colour and cooking losses of meat (*m. longissimus dorsi*).

Strain	pH	Colour			Cooking losses (%)
		L*	a*	b*	
ISt	5.48	41.1	22.4	4.74	31.1
IS25m	5.52	40.3	23.3	5.46	30.8
IS50m	5.53	41.0	23.5	5.69	29.5
IS75m	5.50	40.0	23.9	5.77	30.9
ISm	5.50	39.6	23.2	5.56	30.3
mean	5.51	40.5	23.2	5.43	30.5
s.e.	0.090	2.58	1.89	1.251	3.98
P linear contrast	ns	0.08	ns	0.04	ns

Meat proximate composition changed little with genotype (table 5) while both, the absolute and relative insoluble collagen content, increased with the frequency of Montbeliarde genes (table 6).

Table 5. Meat chemical composition (%), *m.longissimus dorsi*

Strain	Dry matter	Ash	Protein	Lipids
ISt	26.5	1.08	21.9	3.53
IS25m	26.7	1.08	21.7	3.95
IS50m	27.1	1.06	21.8	4.17
IS75m	26.9	1.05	21.8	4.12
ISm	26.8	1.05	21.9	3.73
mean	26.8	1.07	21.8	3.91
s.e.	1.98	0.052	1.10	1.583
P linear contrast	ns	0.03	ns	ns

In the same way, even the toughness of cooked meat increased as the frequency of French ascendance increased (table 6).

Table 6. Meat collagen composition and hardness (*m.longissimus dorsi*).

Strain	Total collagen (g/100g meat)	Insoluble collagen (g/100g meat)	Insolubility (%)	WB shear force (N)
ISt	4.76	3.62	76.8	46.1
IS25m	4.78	3.66	76.6	52.5
IS50m	5.26	4.13	79.0	54.5
IS75m	5.23	4.09	78.6	57.6
ISm	5.17	4.14	81.1	61.4
mean	5.03	3.91	78.2	54.1
s.e.	1.039	0.778	7.45	15.03
P linear contrast	ns	0.01	0.06	0.002

Conclusions

The inclusion of Montbeliarde genes in the IS population has significant effects on carcass and meat traits that should be taken into consideration in the breeding programmes of the dual purpose Italian breed.

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References

- A.S.P.A. (1991). Metodologie relative alla macellazione, alla valutazione e dissezione della carcassa di animali di interesse zootecnico. Agr. Ric., 13, 34.
- ASPA (1996). Metodiche per la determinazione delle caratteristiche qualitative della carne. Univ. Studi Perugia, 1996.
- Besozzi M. (1996). La razza Montbeliarde, per latte e carne di qualità. Informatore-Agrario. 52: 39, 43-45.

- Bonsembiante M., Andrighetto I., Bittante G., Spanghero M., Cozzi G. (1988). Attitudine alla produzione della carne di vitelloni di due razze da latte e quattro a duplice attitudine. *Zootecnica e Nutrizione Animale*. 14, 325-340.
- Dominique J. (1989). *Voyage au pays des Montbeliardes*. Textel. Lione
- El-Hakim A., Eichinger H., Pirchner F. (1986). Growth and carcass traits of bulls and veal calves of continental cattle breeds. 2. Carcass composition. *Animal Production*., 43: 2, 235-243.
- Gigli S. e Romiti A. (1989). Prove sui capi pezzati rossi da carne. *Pezzata Rossa*. 2:1, 25-26 e 2:2,3: 44-46.
- Hegedus M. and Burgstaller G. (1985). Fattening performance and carcass characters of young German Brown X Brown Swiss (GB/BS), German Simmental (GS) and German Black Pied X Holstein-Friesian (GBP X HF) cattle managed intensively. 2. Carcass characters and chemical composition of the back muscle, round and flank. *Bayerisches-Landwirtschaftliches-Jahrbuch*., 62, 27-34.
- Miksik J., Subrt J., Zizlavsky J., Gotthardova J. (1996). Meat production of young, fattened Montbeliard bulls. *Zivocisna-Vyroba*. 41: 9, 381-385.
- Spindler F. (1989). Histoire de la race Montbeliarde jusqu'a la Seconde Guerre Mondiale. [History of the Montbeliard breed up to the Second World War]. *Ethnozootechnie*, 44, 25-36.
- Verbic J. (1998). Effects of crossbreeding Simmental with Red and White Holstein and Montbeliard breed on milk yield. Cepon M., Osterc J., Klopčic M., Zgur S., Rečnik M (ed.) *Agriculture and environment. Proceedings, Bled, Slovenia, 12-13 March. 1998*, 537-543.
- Wyss U. (1988). Breed comparison of fattening trials of intact and castrated cattle. Fattening performance, carcass composition and evaluation. *Mitteilungen-des-Schweizerischen-Verbandes-fur- Kunstliche-Besamung-und-der-Interessengemeinschaft-Schweizerischer-Besamungszuchter*., 26: 3, 8-11.