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Sensory quality of Italian Istrian Milk lamb meat as affected by production system

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SUMMARY – The Istrian Milk (or *Istriana*) is an endangered sheep of the Pramenka group, spread over the Adriatic Karst region of three bordering countries: Croatia, Italy and Slovenia. Its preservation is functional to the protection and restoration of the classic, high ecological value landscape of North-Adriatic uplands. Typification and differentiation are considered very effective in adding value to livestock products and improving their appeal. To provide objective information on the meat quality of Istrian Milk light lamb, the loins (*longissimus dorsi* muscle) of thirty suckling lambs from three theses, differing in rearing practices and feeding regime (milk, milk and concentrates, milk and grazed forage), were analysed. The results showed that there are substantial differences between lamb types in the sensory-perceived qualities of their meat. These differences included texture profile, mainly linked to rearing systems, and various odour and flavour attributes, mainly related to feed consumed by the animal.

Key words: Italian Istrian Milk breed, production systems, lamb meat, sensory quality.

RESUME – *"Effet du système de production sur la qualité sensorielle de la viande des agneaux de race italienne Istrienne à lait". La race Istrienne à lait est une race à risque d'extinction, appartenant au groupe des ovins Pramenka et répandue dans la région transfrontalière du Carso Adriatique en Croatie, Italie et Slovénie. La préservation de cette race est importante pour protéger et rétablir la "lande" du Carso, c'est-à-dire le paysage classique et avec une haute valeur écologique des territoires montagneux de l'Adriatique du nord. La typification et la différenciation peuvent être très efficacement utilisées pour la valorisation économique des produits d'origine animale et pour augmenter l'intérêt des consommateurs. Avec le but de fournir des informations objectives sur la qualité de la viande des agneaux légers de race Istrienne à lait, on a analysé le muscle* longissimus dorsi *de 30 agneaux nourris sous la mère appartenant à trois lots, différents par la technique d'élevage et le régime alimentaire : lait, lait et aliment concentré, lait et fourrage pâturé. Les résultats ont mis en évidence d'importantes différences parmi les différents types d'agneaux, concernant la qualité sensorielle de leur viande. Ces différences comprennent le profil de texture de la viande, principalement lié au système d'élevage, et aussi différentes propriétés gustatives et olfactives, essentiellement dépendantes de l'alimentation des animaux.*

Mots-clés : *Race Istrienne à lait italienne, système de production, viande ovine, qualité sensorielle.*

Introduction

The population of Istrian Milk (Mason, 1996) or *Istriana* sheep at the Karst region of three bordering countries, Croatia, Italy and Slovenia accounts for about two thousand heads. The preservation of this endangered, Pramenka group sheep is important in the context of genetic variability conservation and it is functional to the protection and restoration of the classic, high ecological value landscape of North-Adriatic uplands, characterised by the presence of dry grasslands fenced by stone boundary walls and small wood patches. Created by man's deforestation as far as from Neolithic times and maintained by means of millenary low-intensity agricultural practices and extensive pastoral activities, the Karst open land is endangered by shrubs encroachment and reforestation processes, associated with the abandonment of agriculture and a decline of animal husbandry.

The Istrian Milk is a medium sized ovine; the shaggy and open-flock fleece is typically whitish with black or dark-brown spots and patches. Nowadays, permanent and semi-permanent herds represent the widespread type of farming system, the typical products of which are milk, for cheese making, and lamb meat, provided by young animals slaughtered at the age of 5-6 weeks and weighing 12 to 25 kg. The sheep is also currently raised for meat production only; in this case, the production system has extensive connotations.

Attractive countryside maintenance, habitats restoration and endangered animal genetic resources conservation are performed by multipurpose farms. The livestock enterprises integrate traditional animal husbandry purposes with sustainable landscape and nature resources management and get more and more involved in artisan and farm processing, promotional activities and marketing initiatives. Typification and differentiation are considered very effective in adding value to livestock products and improving their competitiveness. Istrian Milk lamb has been included in the reference list of Italian traditional agricultural food products.

As highlighted in a previous research (Piasentier *et al.*, 2002), the combination of feeding system and carcass weight enables the production from Istrian sheep of various lamb types, differing in carcass quality, and meat appearance, tenderness, chemical and dietetic properties. This study integrates those findings, offering a scientific insight into the variability of Istrian lamb meat organoleptic properties in relation to the rearing practices and feeding system, which are known to be an effective factor of variability on meat sensory quality (Sañudo *et al.*, 1998; Fisher *et al.*, 2000; Geay *et al.*, 2001).

Materials and methods

Production system and carcass category

Istrian lamb meat was obtained from 30 carcasses of male lambs 6 to 14 weeks old, belonging to three, equally numerous groups. The lambs in the first two groups, born in a flock fed only forage, were fed either exclusively on mothers' milk (milk-milk, MM) or on mothers' milk and forage (milk and forage, MF), directly grazed at pasture during a 4-week finishing period. The lambs of the third group were fed mothers' milk and concentrate with a crude protein content of 20% as feed, supplied at a daily rate of 100 g/head (milk and concentrate, MC). The age of slaughter was 6 to 10 weeks for MM and MC lambs and 10 to 14 for MF lambs.

All carcasses, classified in accordance with the EU standards (EEC Regulations No. 2137/92 and No. 461/93), belonged to the light ovine type, as they weighed ≤13 kg. However, while all MM carcasses fell into the weight category A (≤7 kg), MF and MC carcasses were heavier and fell into both B (7.1-10 kg) and C (10.1-13 kg) categories.

Meat samples

The day after slaughter the loin (muscle *longissumus dorsi*, from 6th thoracic vertebrae to 6th lumbar vertebrae) whose the pH varied within the normal values range accepted for commercial meat [mean 5.46; standard error (SE) 0.063], was removed from the right side of each chilled (at 2-4°C) carcass, vacuum packed, aged at 4°C for seven days before freezing and kept at –20°C until tasted.

Before sensory analysis, samples were allowed to thaw in a refrigerator (+5°C) for 24 h. Cubic samples, 3 cm-side, were prepared and then cooked in a pre-heated oven at 120°C for 20 minutes, the time necessary to reach a temperature of 75°C at the heart of the sample, as monitored by a K-type thermocouple. Samples were then wrapped in aluminium foil, identified with a three-number code and served hot to the assessors.

Sensory analysis

Sensory analysis was performed in a laboratory (UNI-ISO 8589) to determine a sensory profile (ISO-DIS 13299.2) employing eight trained assessors. For each thesis ten samples were tested in five sessions (replicates). Assessor responses were recorded on score cards with 100 mm linear anchored scales. After a preliminary phase of selection and validation (Meilgaard *et al.*, 1991), 14 descriptors were chosen, to represent texture and flavour characteristics (Table 1).

Table 1. List of sensory descriptive terms with labels and definitions used for the evaluation of Istrian Milk light lamb meat

Term	Label	Definition
Texture		
Initial juiciness	ij	Juiciness perception after the first three bites
Juiciness persistency	jp	Persistency of liquid release during mastication
Hardness	h	Strength needed to penetrate sample (1 bite)
Chewiness	c	Number of bites needed to prepare sample to the dimension required for swallowing
Fibrousness	f	Fibers dimension evaluated at the end of mastication before swallowing
Flavour		
Broth odour	bo	Beef broth odour assumed as reference
Sweet odour	so	Fresh whey odour
Milk odour	mo	Milk served at room temperature
Sheep odour	eo	Aromatic perception associated with fat/tallow from sheep. Sheep wool
Liver odour	lo	Solid liver, liver homogenates odour
Sour taste	st	Basic taste on the tongue associated with acids (e.g. citric acid)
Metallic/bloody taste	mt	Aromatic taste sensation associated with raw lean meat, cooked blood, serum, Ferrous Sulphide
Mouth coating	mc	Physical perception due to soluble fat (butter, bacon)
Flavour persistency	fp	Time persistency of flavour; evaluated at the end of mastication

Statistical analysis

Anova analysis was carried out for each texture and flavour characteristic (Y) in order to investigate the feeding regime (F) fixed effect. In particular, the following mixed model: $Y_{ijk} = m + F_i + A_j + FA_{ij} + R_k + AR_{jk} + E_{ijk}$ was adopted by considering that in every replicates (R), each assessor (A) received on a separate plate 3 meat samples, one per feeding regime, on the basis of a balanced statistical design.

Generalised Procrustes Analysis, GPA (Dijksterhuis, 1996), was performed by Senstools v. 3.1.4 (OP&P Products Research B.V., Utrecht, The Netherlands) on panel data, to make an average groups configuration of the three meat types, obtained from Istrian lambs reared on different feeding systems, on the basis of their sensory profiles. The results were displayed in a bi-dimensional GPA group average space, where the variance of each lamb meat type was showed around its plotted point.

The original sensory descriptors were drawn as vectors in the groups average configuration by using their correlation with GPA space dimensions.

Results and discussion

Means of the sensory attributes of the meat types from Istrian Milk light lambs, assessed by a trained taste panel, together with the univariate analysis for each considered descriptor as affected by production systems are presented in Table 2. All the descriptors received low or moderate scores, revealing a broad perception of delicacy regarding all meat types, which belonged to a common commercial category obtained from young milk-fed lamb.

Nevertheless, there was a clear differentiation between meat types for texture attributes. In fact, the meat of the oldest, pasture-fed suckling lambs was judged as less tender, higher in chewiness and more fibrous than that of the youngest, solely-milk or milk-and-concentrate-fed, stabled lambs. The differences in age and physical activity between lamb groups may confound the effect of feeding and explain the observed meat type variability. Concerning MC and MF meat types, the mean ratings of tenderness are in accordance with the loin value of Warner Bratzler shear force reported for Istrian

Milk light lamb deriving from the same rearing systems (Piasentier *et al*., 2002; 32.6 vs 46.6 N; $P < 0.05$, respectively, for MC and MF lambs). The growth rate of MF, slower than of MC lambs, may have decreased the extent of muscle *post-mortem* tenderisation (Vestergaard *et al*., 2000).

Table 2. Sensory profile of meat types from Istrian Milk light lambs reared on three feeding systems

Term	MM	MC	MF	Mean	SE†
Texture					
Initial juiciness	32.0	32.1	27.8	30.6	5.46
Juiciness persistency	27.4	26.0	23.4	25.6	5.71
Hardness	10.1[b]	15.5[b]	25.8[a]	17.1	5.12
Chewiness	15.7[b]	21.9[b]	33.9[a]	23.8	6.98
Fibrousness	17.9[b]	22.7[b]	29.9[a]	23.5	5.45
Flavour					
Broth odour	6.8	9.2	8.5	8.2	3.22
Sweet odour	24.3	23.2	23.7	23.7	6.75
Milk odour	24.9	19.4	17.7	20.7	8.11
Sheep odour	30.2	28.8	37.1	32.1	6.79
Liver odour	27.9	26.1	29.4	27.8	7.10
Sour taste	32.0	32.1	27.8	30.6	2.88
Metallic/bloody taste	29.3[a]	23.1[b]	24.1[b]	25.5	3.89
Mouth coating	26.7	25.3	29.2	27.1	6.40
Flavour persistency	28.3[b]	25.7[b]	36.4[a]	30.1	6.31

†Root mean square of the interaction "feeding system x assessor" mean square, on which the fixed effect was tested.
[a,b]$P \leq 0.05$.

The production system also influenced some aspects of the lamb meat flavour profile, most likely because of the feed. The MF animals, reared on milk and herbage, produced meat characterised by a higher flavour persistency ($P < 0.05$) than that of meat from both MM and MC. On the other hand, MM meat gave a perception of metallic/bloody taste, higher than in the meat from the other two groups.

The use of the multivariate procedures allowed a comparison of the differences between meat types in terms of the overall pattern of sensory attributes. The GPA (Fig. 1) provided evidence that lamb meat from different production systems was well resolved on the basis of sensory profile. The meat type variance, plotted around each meat type average point, is relatively small, hence indicating good accordance across replicates and validity of the obtained results.

The meat group averages are, in Fig. 1, overimposed on the plot of correlations between the individual assessor mean attribute scores and the group average dimensions, thus allowing to infer properties of the meat types.

The distribution of the meat types shows that, in the opinion of the panel, the MF meat was very different from both MM and MC meats in the first dimension (78.5% of the total variance accounted for), being the texture the main associated attribute. These descriptors classified the assessed meat into relatively hard, long to chew and fibrous type (MF meat, on the right half of dimension 1), versus relatively juicy type (MM and MC, on the left half). The results are in accordance with those of Piasentier *et al.* (2002) who found that MC meat had a lower water holding capacity, in comparison with MF meat and so released more juice during the first three bites.

The meat from the solely milk-fed lambs was clearly separated along the second dimension from that produced by milk- and concentrate-fed lambs. Many odour and taste descriptors were associated with this dimension, but in a lesser consistent way than texture attributes with the first one. The MM meat appeared to be characterised by fresh sensory notes, such as milk odour and sour and metallic/bloody taste, while the MC meat, which was placed in the bottom half of dimension 2, tended to be associated with the broth odour, a sensory note negatively correlated with the same dimension.

Also Gorraiz *et al.* (2000) found some flavour differences between Spanish *lechal* and *ternasco* lambs, the former giving a higher typical impression of grilled lamb. The MF meat had an intermediate position between the other two meat types along the dimension 2. These differences may be related to the intramuscular fat content and composition (Piasentier *et al.*, 2002). The MF as well as MC meat had a medium fat content, higher than MM meat, but a different proportion of *n*-6 and *n*-3 polyunsaturated fatty acid (PUFA). Linolenic acid and its long-chain *n*-3 derivatives content was higher in MF than MC, as a consequence of the herbage intake, and intermediate in MM meat due to a high phospholipid incidence and the supply of milk from solely forage-fed dams.

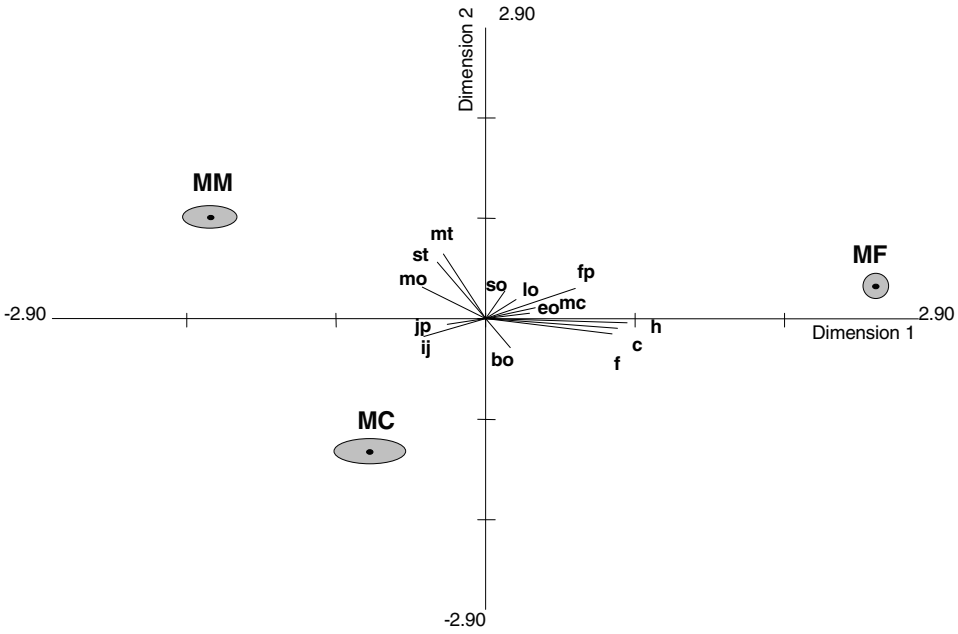

Fig. 1. Average GPA group configuration of meat types from Istrian Milk light lambs reared on different production systems (MM, milk-milk; MC, milk-concentrate; MF, milk-forage) on the basis of 14 sensory descriptors (for label explanation see Table 1), whose correlations with the space dimensions are reported as vectors.

Conclusions

There are substantial differences between Istrian Milk light lamb types in the sensory-perceived qualities of their meat. These differences included texture profile, mainly linked to rearing systems, and various odour and flavour attributes, mainly related to feed consumed by the animal before being slaughtered. The knowledge of sensory characteristics is functional to qualify and value niche ovine production like those considered in this paper, thus supporting preservation of biodiversity and enhancing environmental benefits of traditional farming systems.

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