SENSORY PERCEPTION OF ITALIAN SIMMENTAL BEEF ENRICHED WITH OMEGA-3

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Abstract – The consumer sensory perception of the Italian Simmental (IS) beef in comparison with the Italian Holstein (IH) beef and the effect of the linseed dietary addition were evaluated by 144 people taking part in two triangle tests. Each respondent carried out two comparisons: (IS *vs.* IH) or (IS-linseed *vs.* IH-linseed) in one test and (IS-linseed *vs.* IS) or (IH-linseed *vs.* IH) in the other. The proportion of the population of habitual beef consumers able to detect a sensory difference in beef from bullocks fed with linseed diets (8%, on DM basis) is equal to a maximum of 25%. Irrespective of the type of diet, the IS meat is perceived as different from that of IH, as it stimulates peculiar sensations caused by its intrinsic properties. 43.6% of consumers perceived IS beef as ideal in terms of odor and 41% in terms of juiciness and tenderness, even if 38.5% and 35.9% perceived it respectively as slightly dry and tough compared to how beef should be. Compared to the IH beef, the IS was perceived as ideal by a higher number of consumers (60.3 vs. 37.2%; P<0.05) from the point of view of taste.

Key Words – Breed effect, Consumer perception of beef, Linseed.

I. INTRODUCTION

Consumers are increasingly demanding as regards food quality and increasingly aware that beef production can represent the local production system and can be characterized from a nutritional standpoint [1]. In Italy, in 2011, over 80% of the cows under functional control were of the Italian Holstein (IH) breed, while only 4.4% were of the Italian Simmental (IS) [2]. Despite this, the IS, a dual purpose breed which retains good territorial connotations, has strong potential for differentiating production and is very suitable for a short supply chain perspective and for the organic method. Meat is widely considered an important foodstuff due to the high supply of proteins, vitamins and trace elements. However the relationship between food fats and cardiovascular disease in humans has already been reported [3]. It is therefore a priority to modify the fatty acid profile of meat by increasing the content of polyunsaturated fatty acids (PUFA) and reducing the saturated fatty acids (SFA), with a net effect which leads to a reduction in the ω-6/ω-3 ratio. Various studies have demonstrated the efficacy of flax seeds for increasing levels of PUFA and ω-3 PUFA [4,5]. Other authors have shown how the PUFA can also influence the sensory characteristics of the meat [6].

The aim of this work is to ascertain the specific sensory features of IS meat compared to that of the IH and to evaluate if the addition of linseed in the animals' diet produces perceptible differences on the sensory properties of the meat.

II. MATERIALS AND METHODS

The origin of the beef samples was described in a previous paper [5]. Briefly, from 5 mo of age, 16 weaned Italian Simmental (IS) and 16 Italian Holstein (IH) bulls, with an initial BW of 171 ± 7.3 kg and 181 ± 5.4 kg, respectively, were fed corn silage-grass hay-based diets with, or without, 8% (DM basis) whole ground linseed. Diets were isocaloric and isonitrogenous, totally mixed, and were provided once daily in the morning. Holstein and Simmental bulls were slaughtered at an average BW of 577 ± 24.5 kg (496 ± 19.3 d of age) and 619 ± 19.3 kg (476 ± 24.6 d of age), respectively, at an EU-licensed abattoir. All procedures meet the requirements of the European Community Directive, 86-609-EC for Scientific Procedure Establishments.

One hundred and forty four consumers, divided into groups of eight, took part in two triangle tests organized in two different sessions and carried out in a sensory laboratory [7]. One test was aimed at evaluating the effect of the diet (similarity test) and the other that of the breed (difference test). In particular, each consumer carried out one of the two alternative comparisons in which was organized each test: (IS-linseed *vs*. IS) or (IH-linseed *vs*. IH) in one session and (IS *vs*. IH) or (IS-linseed *vs*. IH-linseed) in the other session, according to a random and balanced distribution pattern [8]. During the test, each consumer received three coded, homogeneous loin samples (triad), was told that two of the them were from the same and one from a different bullock, and was asked to identify the odd sample (forced choice). At the same time as the triangle tests the consumers gave their assessment of: odor, taste, juiciness and tenderness of the samples (five-point just-about-right, JAR, scale) [9]. The loin samples were cooked until a core temperature of 71°C.

The consumers were also asked to score, on a three-point scale (important=1, fairly important=2, unimportant=3), the criteria which guide them in the purchase of beef and the factors which may influence the quality of the meat.

The statistical analysis was carried out with SPSS, release 7.5.2 (SPSS Inc., Chicago, Illinois). The results of the triangle test were analyzed independently for each of the four comparisons carried out. In particular, the significance of the differences between the products and the proportion of discriminant population were obtained through the evaluation of the probability associated with the relationship between the total number of responses and the number of correct answers [10].

The sensory data of the quality type, collected with the JAR scales by only the consumers who correctly identified the different sample, were analyzed independently for each attribute: odor, taste, juiciness and tenderness. For this purpose the tests of Stuart-Maxwell and McNemar were applied [9]. The scores of the consumers on the criteria that guide them in the purchase of beef and on the factors which influence the quality of the meat were analyzed with the tests of Friedman and Wilcoxon for paired samples with the Bonferroni correction as post-hoc test.

III. RESULTS AND DISCUSSION

Eating habits and characteristics of the consumers

Ninety % of the 144 respondents who took part in the sensory evaluations resided in the province of Udine, balanced by gender, and the majority (91%) were aged between 25 and 64 years old, with a good level of education (83% with diplomas and degrees), over two thirds in employment and the remainder housewives (14%), students (12%) and retirees (5%).

All of them claimed they eat beef from bullocks at least 2 or 3 times a month and a third at least 2 or 3 times a week, purchasing it above all from the supermarket (52%), even if a significant 9% is part of a purchase group for meat branded as "Only from the Italian Simmental".

The appearance of the meat is the most important criterion which consumers claimed they adopted when purchasing the product. Other parameters which guide purchase decisions are the territorial origin of the livestock (regional, national or foreign) and the place of purchase. The complexity of the preparation of the cut being purchased and the brand of the meat are instead less influential. As regards the factors that the consumers consider to be decisive for the production of quality beef, the most important one was the cattle feeding regime. Less decisive, even if in any case indicated as important by many consumers, are the methods of cooking and of preparation. Similar attitudes and perception of meat were highlighted with other groups of beef eaters [11].

Sensory perception of meat rich in omega-3

The long-term dietary addition of linseed, rich in α-linoleic acid, in the diet of a bullock, both IS or IF, significantly modified beef fatty acid profile, by increasing the proportions of total n-3 fatty acid, total PUFA, and PUFA:SFA, as shown in previous papers [5,12]. The objective of the triangle test was then to ascertaining if the functional, healthy PUFA enrichment of meat, resulted in a difference on the sensory characteristics of beef perceivable by habitual consumers. Indeed, while Maddock and colleagues [4] found that the inclusion of 8%

DM of flax in the diet of heifers did not influence the sensory characteristics of the meat, LaBrune et al. [13] highlighted that a level of 10%DM of ground flax seeds in the diet of bullocks increases the degree of unpleasant flavor of beef, which trained judges described as: metallic, rancid, acid and slightly bitter.

Table 1. Triangle test evaluating the sensory similarity of beef from bullocks (both, IS or IH) fed on diet without or with linseed (8% on DM basis)

	IS-linseed *vs.* IS	IH-linseed *vs.* IH
Total answers (no.)	72	72
Correct answers (no.)[1]	31	30
Discriminating pop. (%)[2]	25.8	23.7

[1] no. of consumers that correctly identified the odd sample in the triad.
[2] Maximum percentage of the population that, with a probability of 90% (β-risk, i.e. the probability that no perceptible difference exist when one does, equal to 0.10) can distinguish the beef samples.

The results of the triangle testing for beef similarity, are reported in Table 1. Thirty-one consumers out of the 72 who ate the IS meat and 30 of those who ate the IH meat correctly identified the different sample. Thus the test, with a β=0.10 chance of failing, provides the evidence that only a reasonably small proportion of the population of habitual beef consumers, equal to a maximum of 25%, can be able to detect a sensory difference between the meat provided by young bulls fed, irrespectively of breed, without or with linseed, at the level of 8% of the diet, on DM basis.

Specific features of the Italian Simmental meat

The results of the triangle test for confirming that there is a sensorial difference between the IS and IH meat are shown in Table 2. Both the comparisons, the first, carried out by 72 consumers who evaluated the meat of bullocks fed with a traditional diet, and the second, carried out by a further 72 consumers who tasted the meat of animals fed with a diet containing flax, produced the same result: the probability of telling the truth when claiming that the meat of the two breeds is not different is very low, broadly lower than the level of significance *P*=0.01. Therefore, irrespective of the type of diet administered to the livestock, the IS meat is perceived as different from that of IH, as it stimulates peculiar sensations. These sensations are caused by intrinsic properties of the meat as the consumers who perceived them were not informed of the nature of the meat they were tasting. Bureš et al. [14] highlighted that the meat of Simmental cattle could be differentiated from that of Aberdeen Angus, but not from that of Charolais or Hereford.

Table 2. Triangle test evaluating the sensory difference of beef from bullocks of IS or IH breed, fed on diet both with or without linseed

	IS *vs.* IH	IS-linseed *vs.* IH-linseed
Total answers (no.)	72	72
Correct answers (no.)[1]	36	42
Significance[2]	0.001	0.00002

[1] no. of consumers that correctly identified the odd sample in the triad.
[2] Probability to fail claiming that the beef from the two breeds is different.

The JAR judgments expressed after the triangle test by the consumers who correctly perceived the difference between the breeds provide indications on the sensory properties of IS beef. 43.6% of consumers perceived IS meat as ideal in terms of odor.
Juiciness and tenderness were judged as just about right by 41% of the consumers, even if 38.5% and 35.9% perceived it respectively as slightly dry and tough compared to how beef should be (Figure 1). Compared to the IH beef, the IS was perceived as ideal by a higher number of consumers (60.3 vs. 37.2%; P<0.05) from the point of view of taste, and slightly tender (17.9 vs. 5.1%; P<0.05). Conversely the consumers judged with greater frequency the IH meat as dry (19.2 vs. 2.6%; P<0.05) and tough (17.9 vs. 3.8%; P<0.05) compared to the IS meat.

I. CONCLUSION

By combining the choice of the breed and of the feeding it is possible to improve the dietetic value of the meat, preserving the favorable perception the consumers have of the sensory properties of the Italian Simmental beef.

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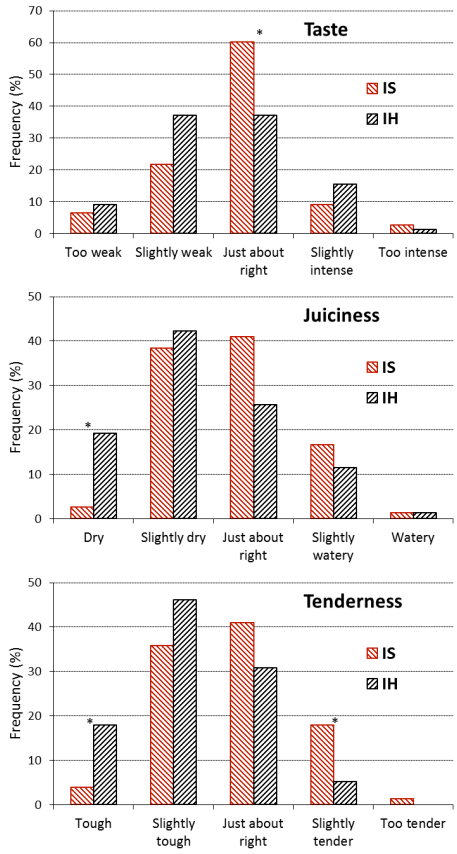

Figure 1. Frequency of the JAR judgments of consumers discriminating the breed on taste, juiciness and tenderness of the beef from IS and IH bullocks. *: difference between breeds for the category of the sensory descriptor $P \leq 0.05$.

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