THE EFFECT OF RED CLOVER SILAGE ON FATTY ACID COMPOSITION AND SENSORY QUALITY OF MEAT FROM HAMPSHIRE CROSSES WITH AND WITHOUT THE RN⁻ ALLELE

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BACKGROUND AND OBJECTIVES

The dominant RN⁻ allele occurring in the Hampshire breed is associated with a high glycogen content in glycolytic muscles (Le Roy et al., 1990). The allele is common in Swedish Hampshire and is present in about 70% of the Hampshire crosses (Enfält et al., 1994). In a previous experiment the RN⁻ allele was found to have a positive effect on the sensory quality (Lundström et al., 1996). The interest for alternative feedstuffs for pigs such as silage has increased, but little is known about its effect on the sensory quality of pork. The purpose of the present study was to study the effect of red clover silage on fatty acid composition and sensory quality of meat from Hampshire crosses with and without the RN⁻ allele.

METHODS

Animals: The animals used were 40 cross-bred slaughter pigs with Hampshire as terminal sire and Landrace x Yorkshire sows. Each litter was split into two, and half of the animals were fed red clover silage (1.25 kg per day, equal to 8% of the total daily energy intake) during at least one month before slaughter, and the other half were fed conventional feed during the entire rearing period. The pigs were slaughtered and graded in a commercial slaughter house at 108 kg live weight.

RN⁻ allele determination: Animals were classified for RN phenotype according to the amount of residual glycogen in *M. longissimus dorsi* (Lundström et al., 1996), and individuals with ≥40 µmol per g wet weight were regarded as carriers.

Lipid content and fatty acid composition: The intramuscular fat content (IMF) was analysed after hydrolysis, using petroleum ether for extraction (Soxtec System H⁺ equipment, Tecator AB, Höganäs, Sweden). The lipid for fatty acid analysis was extracted in accordance with Folch et al. (1957). The fatty acid esters were methylated by sulphuric acid in methanol at 60°C over night and separated by gas liquid chromatography. The relative proportion of each fatty acid has been expressed as the relative percentage of the sum of the fatty acids, but also as the total percentage after considering the IMF content and using the conversion factor of 0.91 for lean pork (Statens Livsmedelsverk, 1989).

Sensory analysis: At cutting, both sides of the front part of *M. longissimus dorsi* was vacuum packed and aged for 4 or 8 days at 4°C before freezing. A descriptive test was carried out by a semi-trained panel (7 panel members) on *M. longissimus* samples from 24 animals. The meat was prepared in one piece in a conventional oven at 150°C until a centre temperature of 68°C, cut in 3 mm slices, reheated and served hot. The meat was scored for tenderness, juiciness, and intensity of meat and acidulous taste.

Statistical analysis: The statistical analysis was carried out with the Statistical Analysis System (SAS Institute, 1991, 1994), using the GLM-procedure. Levels of significance were: n.s. = $p > 0.05$; * = $p \leq 0.05$; ** = $p \leq 0.01$; *** = $p \leq 0.001$.

RESULTS AND DISCUSSION

The results from the sensory analysis showed that the RN carriers had a more juicy meat with more intense meat taste and acidulous taste (Table 1). Silage feeding had a negative effect on juiciness for both phenotypes (Table 1), while RN carriers on conventional feed scored highest for tenderness (Fig. 1). Eight days of ageing gave a more tender meat ($p \leq 0.001$) with less intense acidulous taste ($p \leq 0.001$). Juiciness scored lowest in meat from silage-fed pigs with short ageing time. The total loss during thawing and cooking was higher in RN carriers than non-carriers (26.9 vs 23.8%; $p \leq 0.05$). The long aging time caused a higher drip loss during thawing (4.3 vs 3.6%; $p \leq 0.01$).

As regards the higher scores for acidulous taste and meat taste intensity for RN carriers the results are in agreement with our earlier results (Lundström et al., 1996). The higher meat taste intensity for RN carriers was, however, not observed when sliced loin samples were fried in fat (Lundström et al., 1995). The higher tenderness in RN carriers fed conventional feed is in agreement with the lower shear force value reported by Lundström et al. (1996). In contrast to the positive effects of the RN⁻ allele on sensory properties that were found in the Swedish studies, Le Roy et al. (1996) reported an inferior texture with a reduction in tenderness, juiciness and mellowness, and a positive effect was found only on flavour. The more tender meat found after prolonged ageing was also in agreement with Tornberg et al. (1994). There are few reports of the effect of pasture on the sensory properties of meat. Lucerne caused an atypical taste in lamb meat described as 'sharp' and 'sickly' (Park et al., 1972). Leaf nutrient concentrate fed to rainbow trout gave an obvious grassy taste, and an atypical trout taste (Johansson et al., 1991).

The results from the fatty acid analysis showed that the RN⁻ allele did not affect either the intramuscular fat content or the fatty acid composition. Silage feeding on the other hand decreased the amount of intramuscular fat (2.3 vs 1.6%; $p \leq 0.001$)

but increased the proportion of polyunsaturated fatty acids (PUFA), and also the quotient between the omega-3 and omega-6 fatty acids (Table 2). When, however, the proportion of the PUFA was corrected for the fat content, this difference was reversed ($p \leq 0.05$). The quotient between omega-3 and omega-6 was still higher after silage feeding also when correction was made for IMF content.

The red clover silage had a high level of polyunsaturated fatty acids which also had an effect on the fatty acid composition of the pork. This may be beneficial from a health point of view, but due to the lower IMF content this finding is of little importance when consuming the meat. It should also be noted that unsaturated fatty acids might undergo oxidation during storage causing rancidity or off-flavour in the meat, and thereby shorten the shelf-life.

CONCLUSIONS

The RN^- allele is positive for all eating quality attributes for loin prepared in the oven but caused an increased cooking loss. Increased ageing time is positive for both tenderness and meat taste intensity, while silage feeding is negative for tenderness and juiciness.

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Table 1. Sensory attributes for pork (*M. longissimus dorsi*) from carriers and non-carriers of the RN allele fed conventional feed or silage

Sensory attribute[1]	RN^-rn^+	rn^+rn^+	Level of sign	Conv. feeding	Silage feeding	Level of sign.
Meat taste	3.4	4.0	***	3.6	3.8	ns
Acidulous taste	4.8	5.7	***	5.2	5.3	ns
Juiciness	4.5	5.2	***	4.6	5.1	***

[1]Score 1-9 from low to high.

Table 2. IMF content and fatty acid composition of *M. longissimus dorsi* of pigs fed conventional feed or red clover silage

Fatty	Relative percentage		Level of sign.	Total percentage		Level of sign.
	Conv. feeding	Silage feeding		Conv. feeding	Silage feeding	
IMF, %	2.3	1.6	***	---	---	---
MUFA	48.3	45.4	**	1.01	0.68	***
PUFA	15.6	19.3	**	0.31	0.27	*
omega-3	2.0	2.8	***	0.04	0.04	n.s.
omega-6	13.6	16.5	**	0.24	0.27	*

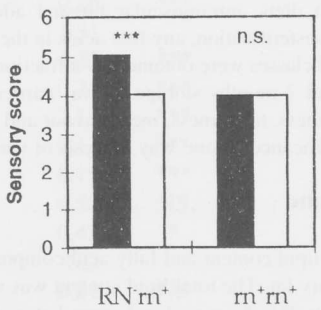

Fig. 1. Tenderness in RN carriers and non-carriers fed conventional feed (■) or silage (□).