SENSORY AND BIOPHYSICAL PROPERTIES OF PORK

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Introduction

Sensory quality is a very important criterion for man's choice of porcine meat. It has recently been noted that many consumers consider that meat has a lower quality today than ten years ago (1). It is of further interest to note that consumers are disposed to paying for high quality meat (1, 7).

To increase the possibility of offering consumers porcine meat of high quality, skeletal muscle characteristics of living animals, carcass characteristics, biophysical properties of muscle (i.e. waterholding, fatholding) and cooking temperature were studied in relation to sensory properties in a series of investigations.

Materials and Methods

Samples of M. longissimus dorsi were taken from purebred Hampshire (H), Swedish Landrace (SL) and Swedish Yorkshire (SY) pigs.

Biopsy samples were taken from five pigs of each breed about one week prior to the estimated slaughter day. The contents of triglycerides and glycogen and the enzyme activities representing oxidative and glycolytic pathways were analysed. The enzymes citrate synthase (CS) and 3-OH-acyl-CoA-dehydrogenase (HAD) were used as indicators for the oxidative pathways and triosephosphate dehydrogenase (TPDH) and lactate dehydrogenase (LDH) as indicators for the glycolytic pathways (2).

Carcass characteristics (i.e. daily live weight gain, slaughter age, backfat thickness and percentage lean in carcass), meat quality traits (i.e. final pH-value, EEL colour value, and content, composition and distribution of intramuscular lipids), content and distribution of intramuscular water and sensory properties of LD from the three pig breeds were evaluated. The number of samples for each breed is given in Table 1.

The pigs were reared, slaughtered and chilled in the same manner and these parameters are described in detail by Fjelkner-Modig & Persson (4). A description of the methodology used for the analyses of the carcass characteristics, the pH- and colour values and the intramuscular lipid content is given by Fjelkner-Modig & Persson (4). The methods used for the analysis of composition and distribution of intramuscular lipids as well as the pulse-NMR-method used for the analysis of intramuscular water distribution is given by Fjelkner-Modig & Tornberg (5, 6). Moreover, the methodology used for the sensory analysis of juiciness (evaluated as initial and visible juiciness and dryness in mouth), tenderness (evaluated as hardness, stringiness, chewing time and chewing residual) and flavour of LD samples fried to centre temperatures of 60, 68 and 80°C are reported by Fjelkner-Modig (3).

The influence of carcass characteristics, meat quality traits and biophysical properties on the sensory properties of LD were estimated by the method of least squares analysis of data using the Genereal Linear Models Procedure in the Statistical Analysis System (8).

Results and Discussion

Sensory properties of pork as related to breed and cooking temperature

The results of the sensory evaluation of juiciness and tenderness of M. longissimus dorsi fried to centre temperatures of 60, 68 and 80°C are diagrammatically shown per breed in Fig. 1. The juiciness is estimated as the average value of the three sensory attributes; visible and initial juiciness and dryness in mouth as these three attributes were highly correlated (3). Also the sensory attributes hardness, stringiness, chewing time and chewing residual were highly correlated (3). The average value of these four attributes was therefore calculated per breed and cooking temperature indicating the overall impression of tenderness.

As is evident in Fig. 1 the impression of both juiciness and tenderness was highly affected by breed and cooking temperature. The samples of Yorkshire were throughout less tender and less juicy than the samples of the other two breeds. The samples of Hampshire were more tender than those of Swedish Landrace, whereas a difference in juiciness between the two breeds was noted solely for the end-point temperature of 80°C (Fig. 1).

The flavour impression of the samples was not influenced by either breed or end-point cooking temperature. All the samples were estimated as having a moderate flavour intensity.

The samples fried to an end-point temperature of 60°C were more juicy and tender than those fried to higher temperatures. However, samples which had been fried to a centre temperature of 60°C were pink in the middle. Many of the assessors made comments on the pinkness, finding the meat samples somewhat raw. Thus, from the sensory point of view a final temperature of 65-70°C is preferable to 60°C.

Sensory properties of pork as related to skeletal muscle characteristics

The enzyme activities representing oxidative (CS, HAD) and glycolytic (TPDH, LDH) pathways as well as the content of the intramuscular substrates glycogen and triglycerides differed between the three breeds (Fig. 2).

The samples of Hampshire had the highest glycogen and triglyceride values and those of Swedish Yorkshire the lowest. The highest oxidative and the lowest glycolytic potentials were noted for the samples of Hampshire, whereas the samples of Yorkshire had the lowest oxidative and the highest glycolytic potentials. The samples of Swedish Landrace had values for the glycolytic and oxidative potentials and for the intramuscular substrate in between the values for the samples of the Hampshire and the Yorkshire breeds (Fig. 2).

The samples of Hampshire were the most tender and juicy and those of Yorkshire least tender and juicy. Essén-Gustavsson & Fjelkner-Modig (2) suggested therefore, that the sensory properties of pig meat are related to the enzyme activities and intramuscular substrate stores in the muscle of live pigs. A high oxidative capacity, a low glycolytic capacity and high intramuscular contents of glycogen and triglyceride were associated with high tenderness, juiciness and flavour of pig meat.

Sensory properties of pork as related to carcass characteristics, meat quality and water traits

The results of the analyses of carcass characteristics and meat quality traits are reported by Fjelkner-Modig & Persson (4) and Fjelkner-Modig & Tornberg (5). The content and distribution of intramuscular water is reported by Fjelkner-Modig & Tornberg (6). In this paper, only the relationships noted between the above-mentioned parameters and the sensory properties are discussed.

A summary of the relationships is given in Table 1 and as evident from this table different relationships were noted for each breed.

Backfat thickness and percentage lean in carcass were highly interrelated ($r \geq -0.75$) for the samples of Hampshire and Swedish Yorkshire (4). As is evident in Table 1 an increase in percentage lean in carcass (SY) and a decrease in backfat thickness (H) is associated with a decrease in tenderness of LD in the two breeds. Furthermore, an increase in live weight gain is associated with a decrease in tenderness for the samples of Yorkshire, whereas the opposite is true for the samples of Hampshire. It could, therefore, be concluded that the tenderness of LD from both Hampshire and Yorkshire is related to backfat thickness, percentage lean in carcass and live weight gain.

The sensory properties of LD from Hampshire were not related to the meat quality traits. For the samples of the other two breeds an obvious influence of intramuscular lipid content was noted on the impression of both juiciness and tenderness. An increase in intramuscular lipid content was associated with an increase in tenderness and juiciness.

Furthermore, for the samples of Swedish Landrace an influence of colour value was noted on the sensory properties, implying that a high colour value (i.e. PSE-meat) was associated with low juiciness and tenderness.

The sensory properties of LD from Yorkshire were not affected by colour value but by composition and distribution of the intramuscular lipids and by final pH-values. The tenderness was positively related to a high amount of saturated fatty acids and to a low number of small fat depots.

The content and distribution of intramuscular water has hitherto been studied by pulse-NMR in LD from Hampshire and Yorkshire. This investigation indicates that the distribution of intramuscular water highly affects the impression of juiciness and also that of tenderness for the samples of Hampshire. Juiciness is mainly governed by the intramuscular water deposited in the largest pores, whereas the water within the myofibrils contributes to a large extent to the tenderness, especially at the end-point temperature of 80°C.

Conclusion

The sensory properties of pork are highly affected by breed and end-point temperatures by cooking. The samples of Hampshire were overall the most tender and juicy. The tenderness and juiciness of LD from Swedish Landrace could be improved by producing pigs with a higher intramuscular lipid content and a lower frequency of PSE. The sensory properties of Swedish Yorkshire could be improved by producing slower growing pigs with a lower percentage of lean in carcass and a higher intramuscular lipid content.

References

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* These papers are included in the thesis by Fjelkner-Modig, S. (1985) "Sensory and biophysical properties of pork", available from the Swedish Meat Research Institute, POB. 504, S-244 00 Kävlinge, Sweden.

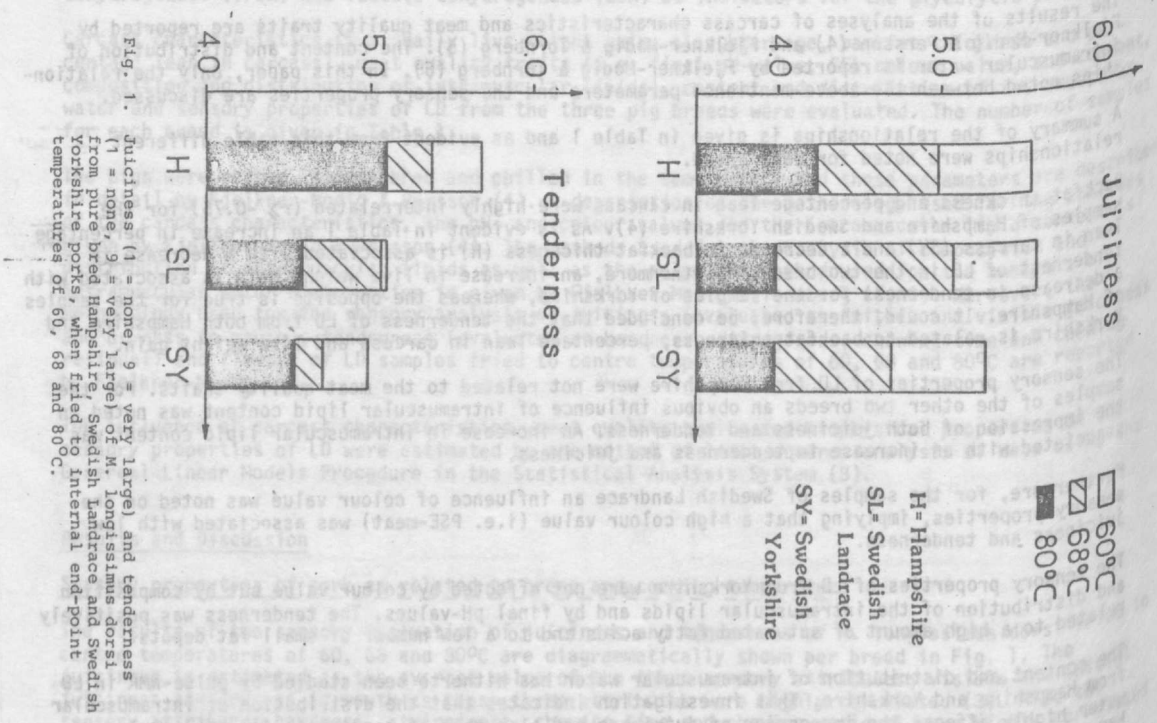

Fig. 1. Juiciness (1 = none, 9 = very large) and tenderness (1 = none, 9 = very large) of M. longissimus dorsi from pure bred Hampshire, Swedish Landrace and Swedish Yorkshire porks, when fried to internal end-point temperatures of 60, 68 and 80°C.

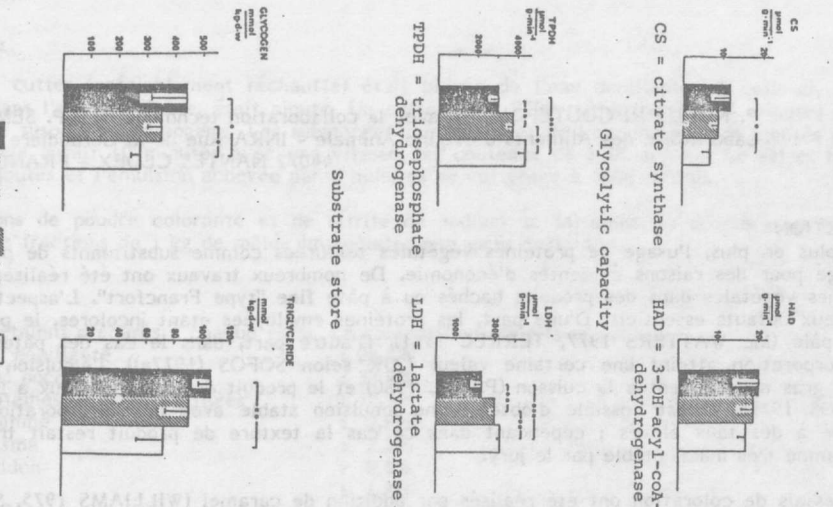

Fig. 2. Enzyme activities representing oxidative and glycolytic pathways and intramuscular substrates indicated as average value and standard deviation in M. longissimus dorsi from Hampshire, Swedish Landrace and Yorkshire.

Breed	Sensory property	Carcass traits Variables	R^2	Sign. level	Meat quality traits Variables	R^2	Sign. level
Hampshire (n=42)	Juiciness			ns			ns
	Tenderness	+B, +G	20	*			ns
	Flavour			ns			ns
Swedish Landrace (n=29)	Juiciness			ns	$+L_i$, -C	35	**
	Tenderness			ns	$+L_i$, -C	27	*
	Flavour			ns			ns
Swedish Yorkshire (n=48)	Juiciness			ns	$+L_i$, -pH	15	*
	Tenderness	-L, -G	20	**	$+L_i$, +SFA, -FD	53	** 1)
	Flavour	-G	9	*	+C, -pH	15	*

1) n=20

Table 1. The general relationships of sensory properties and carcass traits [i.e. live weight gain (G), backfat thickness (B) and percentage lean in carcass (L)], meat quality traits [i.e. colour value (C), pH (pH) and intramuscular lipid content (Li), amounts of saturated fatty acids (SFA) and small fat depots (FD)] of M. longissimus dorsi, pork, noted by a stepwise multiple linear regression analysis.