PORK QUALITY AS AFFECTED BY ANIMAL AGE AND LEAN COLOUR

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SUMMARY:

A total of 32 female pigs of similar carcass lean proportion were used to study the effects of age (mean 189 or 206 days) and lean colour (assessed visually as "pale" or "dark" on the carcass) on *M. Longissimus lumborum* (LD) chemical composition and sensory traits. The two factors had no significant effect ($P > 0.05$) on dry-matter, heme pigments, collagen nor lipid contents. However it was noted a tendency towards higher pigments content and lower collagen content in "dark"-lean pigs. Age did not affect the sensory traits of LD but a darker lean colour was accompanied by higher tenderness and juiciness scores. It was concluded that lean colour could be a useful indicator of pork sensory traits for early evaluation of meat quality on pig carcasses.

INTRODUCTION

Pig producers are facing an increasing demand for high-quality raw meat. In various european countries, consumers can now buy pork of known characteristics. In France, for instance, the "Label Porc"(*) guarantees characteristics such as breed, sex, age, live weight, feeding background and rearing method of pigs, slaughter procedure, carcass lean proportion and muscle pH. The minimum age at slaughter required in this case is 182 days. One may expect however that slaughter at a more advanced age could lead to even better sensory properties of pork. Moreover, the great variability of sensory traits of pork from pigs slaughtered at the same age could be due to differences in animal maturity. A trial was thus undertaken to study the respective effects of age and maturity (through lean colour) on meat quality traits (chemical composition and sensory traits).

MATERIAL AND METHODS

Thirty-two female pigs proceeding from six different farms were selected at the slaughterhouse from a population of pigs reared under "Label Porc" conditions. They were all born from Belgian Landrace × Large White boars and halothane-negative French Landrace × Large White sows. They were at least 26-week old and had a similar carcass lean proportion measured by the Fat-O-Meater device (53.7 % ± 1.0). The pH-value measured 8 h post-mortem in the *M. Longissimus lumborum* (LD) was in all cases lower than 6.0. These animals were chosen so that the effects of age and animal maturity could be studied according to a balanced 2×2 factorial design. Animal maturity was assessed subjectively through a visual appraisal of lean colour on carcass at slaughter. Half of the pigs had an age close to the minimum age required by the "Label Porc" ("young" pigs, Y) and the other half were taken among the oldest pigs available at the time of slaughter ("old" pigs, O). Within each group, half of the pigs had a relatively pale carcass lean fraction ("pale" lean, P) and the rest a relatively dark lean ("dark" pigs, D). Pigs were slaughtered in four successive groups of 8 animals each including two animals from each treatment (YP, YD, OP, OD).

At slaughter, mucle LD was excised and was submitted to chemical analysis and sensory evaluation. Dry-matter (105°C, 24 h), intramuscular lipids (Arneth, 1972), heme pigments (Hornsey, 1956) and collagen (Bergman and Loxley, 1963, modified by Bonnet and Kopp, 1984) contents were determined. Corresponding data were subjected to two separate variance analyses in order to test the significance of (1) the difference between the four mean treatment values, and (2) the main factor effects (age, lean

colour, farm) and that of age × lean colour interaction. Meat sensory traits were determined by a trained taste panel according to a incomplete-block design. Tenderness, juiciness and flavour of meat cooked up to a core temperature of 70°C were scored on a 10-point scale. Sensory data were subjected to a variance analysis for the same sources of variation as for the other parameters. Correlation coefficients between carcass characteristics, muscle chemical composition and sensory traits were calculated.

RESULTS AND DISCUSSION

The results of the experiment are presented in Table 1. The mean age was 190 and 206 days in Y pigs and O pigs respectively, while there was no age difference between P and D pigs ($P > 0.05$). Variations in carcass weight and pH in muscle LD were all small and non-significant. Carcass lean proportion ranged from 53.4 to 54.0, and it was slighty but significantly greater in O pigs than in Y pigs ($P < 0.05$).

None of the effects of age, lean colour and age × lean colour on the variables of muscle chemical composition reached significance. However, it was noted a tendency towards a higher collagen content (+ 5 % hydroxyproline) and a lower pigment content (- 5 % Fe) in P pigs when compared to D pigs. Over a wide range of age (150-250 days), Barton-Gade (1977) reported in pigs an increase in muscle pigments content with advancing age. This effect varied according to breed and muscle, but her results indicate that only a small increase in LD pigments content can be expected between the two ages achieved in the present experiment. The results of Prost (1980) also indicate that a two-week difference of age at 6 months of age is not sufficient to cause a significant effect on pig LD collagen content. Though the farm factor was not initially included in the experimental design, it actually had a highly significant effect on the LD collagen content ($P < 0.001$), and to a lesser extent on the pigments content and on the carcass lean proportion ($P < 0.05$).

As observed on chemical composition, age did not affect the sensory traits of meat. The mean age difference achieved in this trial (16 days) was probably too small with respect to the relatively advanced age of the animals to exert a perceptible influence on meat quality. On the other hand, at a similar age, differences in lean colour were accompanied by highly significant differences in meat tenderness and juiciness ($P > 0.01$). The differences in lean colour however were not reflected by significant differences in either pH or pigments content. Cooked LD was scored more tender and juicier in pigs showing a relatively darker lean. Then, the decrease in muscle collagen content, due to a darker lean, though not significant, was sufficient to allow an increase in meat tenderness. A significant effect of farm was also observed on meat tenderness ($P < 0.001$).

The correlation between the variables of sensory evaluation and age, carcass lean proportion and pH were all low (≤ 0.24) and non-significant. This result is not surprising since the variations of the latter variables were minimized according to the experimental design. The correlation between the variables of sensory evaluation and the analytical carcass or meat quality traits (colour, pigments, collagen and lipids) were also low (≤ 0.22) and non-significant, which is in agreement with the findings of Lundström et al. (1979) and DeVol et al. (1988). But the variables of sensory evaluation were all positively and significantly correlated with the carcass weight ($P > 0.05$).

CONCLUSIONS

It may be concluded from this experiment that meat sensory scores, viz. tenderness and juiciness, are improved as lean colour assessed on carcass is darker, in other words as the animals reach a more advanced stage of maturity. Then, as already suggested by Lundström et al. (1979), lean colour could be a valuable indicator of pork quality and could contribute efficiently to the

early objective grading of pig carcasses. But further investigation is needed in pigs of known and comparable genetic background to determine:

1- the most adequate method of colour measurement,

2- the limits of lean colour that would ensure the highest acceptance level of pork by the consumers,

3- the minimum of age that would ensure that most of the pigs present sufficient colour intensity and consequently that these animals are within the limits defined in (2-).

This work confirms the conclusions of DeVol et al. (1988) that pork quality is highly variable, even within a population of apparently comparable pigs. The marked effects attributable to the farm factor highlight the role of the method of rearing (feeding, housing) and also probably that of genetics on meat quality in pigs (Gandemer et al., 1989).

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Table 1. Chemical composition and sensory traits of *M. Longissimus lumborum* in pigs differing in age and lean colour.

	Treatment effect						Analysis of variance (F-value)				
	------ Mean treatment value[1] -----				F-value	r.s.d.	---------- Source of variation[2] ----------				r.s.d.
	YP	YD	OP	OD			Age (A)	Colour (C)	Farm	A × C	
(Degrees of freedom)					(3 , 28)		(1 , 23)	(1 , 23)	(5 , 23)	(1 , 23)	
Age (days)	190[a]	190[a]	206[b]	206[b]	112.6***	2	446.2***	0.0	13.4***	0.0	9
Carcass weight (CW, kg)	81	81	83	87	2.2	5	2.7	1.1	1.6	0.7	5
Lean (% CW)	53.6	53.4	54.0	53.9	0.8	1.0	6.5*	0.2	2.7*	0.0	0.9
pH-8 h post-mortem	5.84	5.82	5.85	5.87	0.4	0.09	0.2	0.0	1.1	0.4	0.09
Muscle chemical composition[3]:											
Dry matter (%)	26.5	26.4	25.6	25.9	2.6	0.7	1.8	0.3	2.0	1.1	0.7
Heme pigments (Fe, µg/g)	2.48	2.57	2.29	2.54	0.4	0.57	0.0	1.0	4.0*	0.2	0.46
Hydroxyproline (µg/g)	537	507	537	516	0.1	124	2.3	0.8	12.0***	0.0	77
Intramuscular lipids (%)	1.2	1.2	1.3	1.2	0.3	0.4	1.0	0.1	0.5	0.5	0.4
Sensory analysis[4]:											
(Degrees of freedom)					(3 , 301)		(1 , 327)	(1 , 327)	(5 , 327)	(1 , 327)	
Tenderness	5.0[a]	5.5[b]	4.8[a]	5.2[b]	7.3***	1.3	1.5	14.3***	4.6***	0.5	1.5
Juiciness	3.1[a]	4.0[b]	3.6[c]	3.7[bc]	6.7***	1.4	0.1	9.5**	1.4	8.0**	1.5
Flavor	4.5	4.4	4.8	4.5	1.4	1.3	1.1	0.8	1.3	1.26	1.5

(1) means on the same row and bearing different superscripts are significantly different (P > 0.05).
(2) significant effect at the level P < 0.01 (**) or P < 0.001 (***).
(3) on fresh matter basis.
(4) scored on a 10-point scale (1, imperceptible to 10, very intense).