A TRIAL TO DEFINE FACTORS AFFECTING PIGMEAT QUALITY

M. SEVERINI, M. TREVISANI, A.R. LOSCHI* and A. VIZZANI
Istituto di Ispezione degli Alimenti di Origine Animale, Facoltà di Medicina Veterinaria, Università degli Studi, Perugia, Italia.

SUMMARY

Longissimus dorsi muscles taken from Goland and Landrace x Large White pigs slaughtered on three different days were analysed for pH, colour, WHC, swelling ability, drip loss, heating loss and percentage of PAS-positive fibres. Muscles were classified on the basis of pH at 1 hour and 24 hours p.m. plus the content of glycogen in the myofibres at 1 hr p.m. Adopting these parameters to group the muscles, a correlation was found between the proposed classes of muscles, colour, drip loss and swelling ability. A less significant correlation was observed with heating loss.

The effect of genotype in colour trait was observed. The effect of day of slaughter in some ultimate pigmeat quality characteristics which are of great importance for the meat processing industry was also shown. This effect was observed either in normal and PSE muscles.

INTRODUCTION

Identifying the most important characteristics of pigmeat to be succesfully processed is of great relevance both for the Italian meat processing industry and the pig producers . Special interest has been given to determining the correlation between pork quality and on-line measurements in order to find the simplest and most rapid methods of predicting final meat quality (Chizzolini et al, 1991). Many factors contribute to determine the meat quality characteristics, but not all of them have been fully investigated. Breed, weight of pigs and halothane phenotype have been recognised as very important traits influencing some aspects of ultimate pork quality (Bendall et al, 1988; Geri et al, 1991; Madarena et al, 1991; Monin et al, 1980-81), and the effect of day of slaughter on the mean value of some measurements has been also observed (Eikelenboom & Nanni Costa, 1988). Predictive measurements on slaughterline are mainly based on a few simple correlations and therefore their effectiveness can be affected by factors which have not been fully considered. Here, we partly report previous results of a study aimed at identifying the most relevant quality characteristics of pigmeat derived from heavy pigs to be processed mainly by curing and aging. The influence of some factors possibly affecting the final meat quality was investigated. Attention was focused on two genetic groups of pigs widely used in Italy for processing and on the importance of the day of slaughter.

MATERIALS AND METHODS

A total of 46 Goland and 20 Landrace x Large White heavy pigs (carcass weight > 120Kg) were used for this study. Animals were slaughtered on 3 different days at 2 different commercial slaughterhouses, which used the same slaughtering process (Table 1).

At 45 min post mortem measurements were made of pH (pH-1)(Hanna Instruments, portable pH-meter HI 8424, Ingold pH-electrode T 406), colour (Minolta Chromameter CR-200; CIE, L*a*b* values, 1976) and water holding capacity (WHC-1) (filter paper absorption method) of the Longissimus dorsi muscle of the right half carcass at the level of the 5th-6th rib.

Table 1

group	abattoir	period	genotype	n. pigs
1				
2	A	June 91	Goland	19
3	A	Dec. 91	Goland	27
	B	Feb. 92	L x LW	20

A sample was taken and frozen in liquid nitrogen and used to prepare sections stained with PAS-method for histological examination and count of glycogen-containing fibres.

A portion of muscle between the 5th rib and the first lumbar vertebrae was isolated. A slice of about 50g was cut out and trimmed into a square shape, it was then put on a metal net inside a box and left to drip at 4°C up to 24 hours after slaughter. The difference in weight was used to determine the percentage of

* Istituto di Tecnica delle Autopsie, Facoltà di Medicina Veterinaria, Università di Perugia, Italia.

drip loss. After the whole muscle had been stored at 4°C for 24 hours another slice was cut from and put into a 10% NaCl solution to determine swelling (gain in weight) after 72 hours at 6°C. At 24 hours pm samples were also taken from the whole muscle to measure WHC (WHC-24), weight loss after heating for 60 min at 80°C (cooking loss), weight loss after heating in a conventional oven (170°C) until the internal meat temperature reached 75°C (roasting loss). The pH (pH-24) and surface colour (L*, a*, b* values) were also measured. WHC-values were expressed as meat area/juice area ratio and values above 2.0 were treated as 2.0 in the statistic evaluation. Colour was espressed as L* value, C* value and H° value (CIE system). Data were analysed with an analysis of variance model (Statgraphics, 1985).

RESULTS AND DISCUSSION

Muscles have been grouped in accordance with the pH-1, pH-24 and percentage of PAS-positive fibres. Muscles with pH-1 higher than 6.2, pH-24 lower than 5.8 and more than 30% PAS-positive fibres were considered as normal, muscles with pH-1 lower than 6.2, pH-24 lower than 5.8 and less than 30% PAS-positive fibres were considered as slightly PSE. Muscles with pH-1 and pH-24 lower than 5.8 and no or very few PAS-positive fibres were considered as PSE, according to previous observations (Severini et al, 1991).

The results of measurements carried out on these three types of muscles are reported in Tables 2, 3 and 4. The results show that within each group of pigs as defined in Table 1 PSE muscles tend to be paler, to have a higher drip loss, and to swell to the same extent or slightly more than normal muscles. The differences in cooking loss and roasting loss between normal and PSE muscles were slight and not significant. However, if the values of normal and PSE muscles are considered independently of their group as defined in Table 1 this trend is no longer evident. Significant differences among the three groups were observed in a number of the parameters considered. Differences were observed between the two groups of Goland pigs, between group three (L x LW) and one of the Goland pig groups and also between group 3 and the two Goland pig groups. Very few differences were found among all three groups. The majority of differences between group 1 and group 2 in both normal and slightly PSE muscles concern various quality traits, except colour. Some of these differences also exist between only one of the first two groups and group 3 or among all three groups. Therefore, it can be concluded that the day of slaughter has significant effect on the quality meat of Goland genotype pigs, but not colour and that this effect is likely to be true for all pigs considered in the present study. The effect of day might be attributed to the period of year as related to different climates (Cenci et al, 1985; Russo et al, 1984), to different feeding regimens or to different phenotypes within the same genotype, such as the presence of Halothane-positive and Halothane-negative pigs. Moreover, it must be stressed that Halothane-negative pigs might consist of pigs of homozygote (NN) and heterozygote (Nn) genotype. This has been reported to have an effect on some meat quality traits (Lundstroem et al, 1985). On the contrary, the differences in colour observed between group 1 plus group 2 (Goland) and group 3 (L x LW) in both normal and slightly PSE muscles do not seem to strictly depend on the day of slaughter. This effect appears to be related to the genotype, since this concerns Goland pigs which were slaughtered on two different days versus L x LW crossbreed pigs.

CONCLUSIONS

The effect of day of slaughter in some ultimate pigmeat quality traits was observed thought further investigation is needed. This effect should be carefully considered in studying the relationship between predictive measurements and pigmeat quality. The effect of day of slaughter and the effect of genotype should be also considered when defining standard characteristics to select pig carcasses.

The present reaserch was partially supported by Ministero Agricoltura e Foreste of Italy

REFERENCES

BENDALL J.R. & SWATLAND H.J., 1985. A Review of the Relationship of pH with Physical Aspects of Pork Quality. Meat Sci., 24, 85-126.

CENCI G., SEVERINI M., VIZZANI A., 1985. Incidenza della condizione PSE nel muscolo L. dorsi di suini macellati in diversi periodi dell'anno. Atti Soc. It. Sci. Vet., 29, 632-634.

CHIZZOLINI R., CAMPANINI G., BADIANI A., BARCHI D., LEONELLI C., MAGNANI U., PAROLARI G., SANDROLINI G., 1991. Valutazione strumentale della qualità della carne suina. 3. Risulati di misure in linea su grande scala. Riv. Suinicoltura, 32, 77-86.

EIKELENBOOM G. & NANNI COSTA L., 1988. Fibre Optic Probe Measurements in Landrace Pigs of Different Halothane Phenotypes. Meat Sci., 23, 9-19.

GERI G., ZAPPA A., FRANCI O., POLI B.M., CAMPODONI G., 1991. Evoluzione delle caratteristiche chimiche-fisiche di muscolo suino da 20 a 200 Kg di peso vivo. Riv. Suinicoltura, 32, 51-54.

LUNDSTROEM K., RUNDGREN M., EDFORS-LILJA I., ESSEN-GUSTAVSSON B., NYBERG L., GAHNE B., 1985. Proc. 36th Annual Meeting EAAP, MP 5.18, Kallithea, Halkidiki, Greece. Cit. Eikelenboom & Nanni Costa, 1988.

MADARENA G., DAZZI G., CAMPESATO E., CAMPANINI G., NOVELLI E., BADIANI A., LEONELLI C., BARCHI D., CHIZZOLINI R., 1991. Valutazione strumentale della qualità della carne suina. Analisi dei risultati ottenuti dalla macellazione di gruppi eterogenei. Riv. Suinicoltura, 32, 53-74.

MONIN G., SELLIER P., OLLIVIER L., GOUTENFONGEA R., GIARD J.P., 1980-81. Carcass Characteristics and Meat Quality of Halothane Negative and Halothane Positive Pietrain Pigs. Meat Sci., 5, 413-423.

RUSSO V., BOSI P., CASINI L., 1984. Variazione stagionale del pH in alcuni muscoli del suino pesante. Riv. Suinicoltura, 24, 45-50.

SEVERINI M., TREVISANI M., LOSCHI A.R., 1991. A trial for early prediction of PSE and DFD pegmeat by measuring pH and the percentage of PAS-positive fibres. Proceed. 37th ICoMST, Kulmbach, Germany, 3, 485-488.

TABLE N°2
RESULTS OF MEASUREMENTS IN NORMAL LONGISSIMUS DORSI MUSCLES

ITEM	GROUP 1 mean±SE	GROUP 2 mean±SE	GROUP 3 mean±SE	LEVEL OF SIGNIFICANCE DAY	GENOTYPE*
n	14	13	10		
pH1	6.45 ±0.04^{a}	6.35 ±0.04^{a}	6.38 ±0.04^{a}	N.S.	N.S.
pH24	5.64 ±0.02^{a}	5.56 ±0.03^{a}	5.63 ±0.02^{a}	N.S.	N.S.
L*1	41.13 ±1.66^{a}	45.18 ±0.87^{b}	41.36 ±0.77^{a}	*	N.S.
C*1	12.26 ±1.28^{a}	12.32 ±0.88^{a}	5.81 ±0.44^{b}	***	***
H°1	1.12 ±0.04^{a}	1.07 ±0.02^{a}	1.13 ±0.06^{a}	N.S.	N.S.
L*24	54.08 ±1.19^{a}	53.00 ±0.98^{a}	50.11 ±1.19^{a}	N.S.	*
C*24	6.26 ±0.32^{a}	7.41 ±0.44^{a}	9.41 ±0.79^{b}	***	***
H°24	0.85 ±0.06^{a}	0.86 ±0.04^{a}	1.11 ±0.03^{b}	***	***
WHC1	1.43 ±0.16^{a}	1.43 ±0.17^{a}	1.69 ±0.26^{a}	N.S.	N.S.
WHC24	1.35 ±0.14^{a}	0.43 ±0.03^{b}	0.62 ±0.05^{b}	***	N.S.
SWELLING**	28.76 ±1.11^{a}	16.27 ±1.11^{b}	19.48 ±0.58^{b}	***	N.S.
DRIP LOSS**	1.50 ±0.12^{a}	0.84 ±0.05^{b}	1.33 ±0.05^{a}	***	N.S.
COOKING LOSS**	36.95 ±0.32^{a}	36.37 ±0.43^{a}	40.38 ±2.82^{a}	N.S.	N.S.
ROASTING LOSS**	32.17 ±1.75^{a}	26.66 ±1.10^{b}	38.44 ±0.71^{c}	***	***

*Goland (group 1+2) versus LxLW (group);
**Expressed as percent value
* P≤0.05; **P≤0.01; ***P≤0.001

TABLE N°3
RESULTS OF MEASUREMENTS IN SLIGHTLY PSE LONGISSUMUS DORSI MUSCLES

ITEM	GROUP 1 mean±SE	GROUP 2 mean±SE	GROUP 3 mean±SE	LEVEL OF SIGNIFICANCE DAY	GENOTYPE*
n	5	12	7		
pH1	6.01 ±0.05^{a}	5.99 ±0.02^{a}	5.96 ±0.04^{a}	N.S.	N.S.
pH24	5.65 ±0.04^{a}	5.56 ±0.04^{a}	5.54 ±0.02^{a}	N.S.	N.S.
L*1	46.98 ±3.39^{a}	44.13 ±1.01^{a}	42.31 ±1.57^{a}	N.S.	N.S.
C*1	13.48 ±1.21^{a}	10.96 ±1.29^{a}	5.93 ±0.35^{b}	**	**
H°1	1.06 ±0.05^{a}	1.10 ±0.03^{a}	1.22 ±0.06^{a}	N.S.	*
L*24	58.67 ±0.83^{a}	54.66 ±0.95^{b}	52.12 ±0.86^{b}	**	*
C*24	8.52 ±0.66^{a}	8.41 ±0.69^{a}	9.68 ±0.62^{a}	N.S.	N.S.
H°24	0.92 ±0.04^{a}	0.87 ±0.05^{a}	1.08 ±0.03^{b}	*	**
WHC1	1.50 ±0.32^{a}	1.12 ±0.09^{a}	1.35 ±0.15^{a}	N.S.	N.S.
WHC24	0.62 ±0.07^{a}	0.41 ±0.03^{b}	0.57 ±0.03^{a}	**	N.S.
SWELLING**	27.62 ±1.45^{a}	17.24 ±0.79^{b}	21.71 ±2.17^{c}	***	N.S.
DRIP LOSS**	2.13 ±0.43^{a}	0.92 ±0.08^{b}	1.28 ±0.06^{b}	***	N.S.
COOKING LOSS**	37.72 ±0.34^{ab}	36.77 ±0.49^{a}	38.87 ±0.42^{b}	*	**
ROASTING LOSS**	36.74 ±4.56^{a}	26.89 ±1.45^{b}	40.08 ±0.41^{a}	***	**

*Goland (group 1+2) versus LxLW (group);
**Expressed as percent value
* P≤0.05; **P≤0.01; ***P≤0.001

TABLE N°4
RESULTS OF MEASUREMENTS IN PSE LONGISSUMUS DORSI MUSCLES

ITEM	GROUP 1 mean±SD	GROUP 2 mean±SD	GROUP 3 mean±SD
n	0	2	3
pH1	-	5.65 ±0.06	5.59 ±0.19
pH24	-	5.43 ±0.03	5.56 ±0.10
L*1	-	48.93 ±1.38	49.33 ±6.55
C*1	-	13.74 ±1.95	7.65 ±1.64
H°1	-	1.02 ±0.03	1.13 ±0.18
L*24	-	57.62 ±0.85	52.41 ±4.41
C*24	-	6.64 ±0.83	9.75 ±2.35
H°24	-	0.83 ±0.01	1.12 ±0.05
WHC1	-	1.09 ±0.32	1.00 ±0.52
WHC24	-	0.49 ±0.10	0.65 ±0.04
SWELLING*	-	21.98 ±3.11	19.51 ±1.25
DRIP LOSS*	-	1.33 ±0.05	2.04 ±0.61
COOKING LOSS*	-	36.24 ±1.19	38.23 ±0.22
ROASTING LOSS*	-	25.90 ±6.12	38.50 ±1.52

*Expressed as percent value