DISCRIMINATION BETWEEN PORK LONGISSIMUS MUSCLES WITH EXCESSIVE AND ACCEPTABLE DRIP LOSS

G. Kusec*, G. Kralik, I. Djurkin, A. Petricevic, V. Margeta, D. Hanzek and Z. Maltar

Department of Special Zootechnics, Faculty of Agriculture, Josip Juraj Strossmayer University of Osijek, HR 31000, Croatia

Key Words: Pork, longissimus muscle, meat quality traits, prediction

Introduction

Unfavourable water holding capacity and colour cause major problems in pork industry due to its negative impact on the appearance of meat and the yield in further processing. Since these traits are affected by post mortal glycolysis in the muscle, initial and ultimate pH values are considered as meat quality indicators enabling fair predictions of drip loss and colour. Colour measurements are effective only after cooling and blooming time. Often applied method for measuring water loss in pork is the bag method developed by Honikel (1987). However, the results of this method are known relatively late. For this reason, it is of special interest to differentiate the meat into different classes of drip loss on the basis of measurements which can be made as earlier as possible. Earlier results of water holding capacity can be obtained by the compression method (Grau and Hamm, 1953); initial and ultimate pH values are considered as meat quality indicators enabling fair predictions of drip loss and colour of the meat (Warner et al., 1997; van Laack, 2000; Kusec et al., 2005; Ryu and Kim, 2005). The objective of this paper was to set up a model for discrimination of meat samples into classes of excessive and acceptable drip loss on the basis of meat quality indicators.

Materials and Methods

The present study was carried out on 119 randomly chosen carcasses of barrows, slaughtered at approximately 100 kg live weight in three abattoirs form east Croatia. At the slaughter line, 45 minutes after sticking, initial pH values (pH_i) were taken at the *longissimus dorsi* muscle of primarily processed swine carcasses. After 24 hours of cooling, ultimate pH values (pH_u) were taken; colour of *m. longissimus dorsi* was measured after 15 minutes blooming time. The measurements of pH_i and pH_u were carried out by digital pH-meter “Mettler MP 120-B” and colour by “Minolta CR-300” device at *m. longissimus dorsi* cut after 15 minutes of blooming and presented as CIE L* values. Water holding capacity was measured by compression method (Grau and Hamm, 1952) and by bag method as described by Kauffman et al. (1992); former method being termed as WHC and later as “drip loss” in the present paper. Statistical methods applied were descriptive statistics, cluster analysis and traditional discriminant analysis using STATISTICA (7.0) for Windows program.

Results and Discussion

When compared to literature threshold values (Hofmann et al., 1994; Warner et al., 1997; van Laack, 2000), the meat quality traits of pigs from present study presented in Table 1 indicate desirable meat quality. Only exception is the drip loss measured by bag method which was too high. Variations of measured parameters resemble those reported in literature (Kusec et al., 2005; Ryu and Kim, 2005).

Table 1. Descriptive statistics of investigated meat quality traits

Variable	Mean	Standard deviation	Minimum	Maximum
pH_i	6.09	0.276	5.43	6.62
pH_u	5.63	0.176	5.38	6.46
CIE-L*	46.79	4.898	35.65	59.40
WHC (cm^2)	8.31	1.432	4.30	12.50
Drip loss (%)	5.55	2.754	0.98	14.79

Traditional discriminant analysis model was applied in order to classify samples into groups with high (exudative) and favourable (non-exudative) drip loss on the basis of investigated meat quality predictors (pHi, pHu, CIE-L* and WHC). The first approach was to use threshold value of 5% as suggested by Warner et al. (1997) in order to differentiate between drip loss groups used as the dependant variable; in second analysis the samples were grouped by cluster analysis as shown in Table 2. Results of both discriminant analyses are presented in Table 3.

Table 2. Descriptive statistics of drip loss clusters (exudative and non-exudative)

	Mean	Std. Dev.	Min.	Max	n
Exudative	9.15	1.87	6.78	14.79	34
Non-exudative	4.11	1.40	0.98	6.5	85

Table 3. Classification matrix obtained by classification functions obtained from two discriminant analyses

	Exudative		Non-exudative		Correctly classified (%)	
	Analysis 1 (p=0.471)	Analysis 2 (p=0.286)	Analysis 1 (p=0.529)	Analysis 2 (p=0.714)	Analysis 1	Analysis 2
Exudative	33	8	23	26	58.93	23.53
Non-exudative	22	1	41	84	65.08	98.82
Total	55	9	64	110	62.18	77.31

Rows: Observed classifications; Columns: Predicted classifications (prior probabilities in brackets)

From the Table 3 it is obvious that classification of meat samples into exudative and non-exudative classes by two discriminant functions had different accuracy. When first discriminant analysis was applied, 58.93% and 65.08% of the investigated loin samples were accurately assorted in the classes with excessive and "normal" drip loss, respectively. Overall discrimination percentage was also not high (~62%). Better classification was obtained by second discriminant analysis (performed on the cluster based sampling): almost 99% of the samples in the non-exudative group were classified correct; overall accuracy (~77%) was higher than in first discrimination as well. Discrimination accuracy in exudative class by second analysis was rather low (~24%). Two classes of samples were formed by each discriminant analyses; their meat quality traits are presented in Table 5. When first discriminant analysis was applied, the class of exudative samples had significantly lower ultimate pH values, and higher water holding capacity ($p<0.05$), while initial pH and CIE-L* values were not significantly different ($p>0.05$); by second analysis, only initial pH values and WHC differed significantly between the classes ($p<0.05$).

Table 5. Class means and standard deviations (in brackets) of the meat quality traits used in discriminant analyses

	Discriminant analysis 1				Discriminant analysis 2			
	pH_i	pH_u	CIE-L^*	W.H.C	pH_i	pH_u	CIE-L^*	W.H.C
Exudative	6.06 (0.291)	5.59^a (0.140)	46.76 (4.219)	8.65^a (1.261)	6.01^a (0.288)	5.59 (0.154)	46.91 (4.293)	8.85^a (1.138)
Non-exudative	6.12 (0.261)	5.67^b (0.198)	46.82 (5.465)	8.01^b (1.515)	6.13^b (0.265)	5.65 (0.182)	46.74 (5.143)	8.19^b (1.485)

Means in columns with different superscripts are significantly different ($p<0.05$)

Conclusions

The present study showed that division of meat samples into exudative and non-exudative classes by two discriminant functions had different accuracy. When literature value of 5% was used as criterion for setting the dependant variable, overall discrimination power was not high, but it increased when dependant variable was arranged on the basis of drip loss cluster analysis.

References

1. Grau, R. and Hamm, R. (1952). Eine einfache Methode zur Bestimmung der Wasserbindung im Fleisch. *Die Fleischwirtschaft, 4,* 295-297.
2. Hofmann, K. (1994). What is quality? Definition, measurement and evaluation of meat quality. *Meat Focus International*, *3*, 73-82.
3. Kusec, G., Kralik, G., Horvat, D., Petricevic, A. and Margeta, V. (2005). Differentiation of pork *longissimus dorsi* muscle regarding the variation in water holding capacity and correlated traits. *Italian Journal of Animal Science*, *4*, 79-81.
4. Ryu, Y.C. and Kim, B.C. (2005). The relationship between muscle fibre characteristics, post-mortem metabolic rate and meat quality of pig longissimus dorsi muscle. *Meat Science, 71*, 351-357.
5. Van Laack, R.L.J.M. (2000). Determinants of ultimate pH and quality of pork. Home page address: http://www.nppc.org/Research/00reports/99-129-Laack.htm.
6. Warner, R.D., Kauffman, R.G. and Greaser, M.L. (1997). Muscle protein changes post mortem in relation to pork quality traits. *Meat Science, 45*, 339-352.