GRADING OF GRAIN-FED VEAL CALVES FOLLOWING AN ACCELERATED PROCESSING PROCEDURE

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Rapid chilling methods are used in pork and beef slaughterhouses to reduce bacterial growth and carcass weight losses. Veal processing plants are no different from other plants in this regard. However, compared with meat from other animals, veal is considered delicate. Therefore chilling veal carcasses with the hide-on is still being used in both Canada and United States. It is believed that the skin-on processing of veal prevents the outer surface of the carcass from becoming dark and dry. Even so, the industry is increasingly moving toward skin removal on the kill floor because skinning veal carcasses prior to chilling is mandatory if the product is to be exported to Europe.

Most of the European calves are raised on milk-based products, which produces veal with the pale colour preferred by consumers over a redder type of veal. In Canada, calves are mainly fed with milk-based products as well, but Québec, Ontario and, to a small extent, Alberta produce a substantial number of grain-fed veal calves at a lower cost than milk-fed veal. However, meat of grain-fed veal is redder in colour than the "whitish" meat from milk fed veal. Milk fed calves also produce meat that is quite variable in colour. Increasing the proportion of graded grain-fed veal carcasses on the market would improve the colour homogeneity and quality of the product.

In Canada, the grading of veal is not yet mandatory. Actually, the official grading procedure is carried out by inspection of the brisket after 48 hours of chilling. The industry, would like to be able to grade earlier, to increase the turnover of carcasses in the plants. The problem is that more rapid chilling rates along with the removal of the skin on the kill floor (the skin can act as an insulation layer in the cooler) will slow down colour development at the surface of the *Pectoralis major,* which is the site currently being used to determine colour grade.

Electrical stimulation of carcasses is known to accelerate post mortem glycolysis in muscles. It could therefore present an appropriate technology that might be used to accelerate full colour development and hence allow the earlier grading of rapidly chilled, skin-off, grain-fed veal carcasses. Therefore the effects of rapid vs conventional chilling on the grading of grain-fed veal carcasses, with or without electrical stimulation and at two different carcass locations (*Pectoralis major* and Longissimus muscle), were evaluated.

Protocol

A total of 80 grain-fed veal calves from commercial farms were used in this study. They were slaughtered over a 12-week period in a veal abattoir in Québec using standard procedures. Calves were stunned and bled, and approximately 30 seconds after bleeding, low voltage electrical stimulation (ES) was applied to the carcasses through a nose clamp. Carcasses were grounded through a tail clamp. Stimulation was 90 volts for 40 seconds (i.e. 10 cycles of stimulation alternating 2s on/2s off). The carcasses were then skinned and eviscerated but were not split into halves. Consequently, after weight recording, entire stimulated and non-stimulated (NS) carcasses were evenly distributed to either conventional or rapid chilling treatments. Conventional chilling was at 2°C, with an air speed of approx. 4m/s for 48 hours. Rapid chilling was at 0 to 1° C with an air speed of approx. 10m/s for 18 hours, followed by conventional chilling for another 30 hours. Changes in pH and temperature were monitored in the loin (*Longissimus lumborum*) at a depth of 3 cm with a portable pH meter and a temperature probe at 1, 3, 24 and 48 hours post mortem.

To determine the possibility of early grading, carcasses were graded after 24 hours of chilling, and again at the official grading time, 48 hours after chilling, using the standard procedure. Colour grades in veal are based on the reflectance (Y value in Lux) of the brisket (*Pectoralis major*) after a 30 min blooming period of the exposed surface, using a Minolta colorimeter adapted for veal grading. Colour grades are: A1 = 50+, A2 = 40-49, A3 = 30-39, A4 < 30. In addition to the measurement of the brisket, the reflectance of the bloomed surface of the loin between the 5th and 6th rib was also measured. This corresponds to the regular commercial cutting site for removing the shoulder. These latter measurements were made after 24, 48, 72 and 120 hours (5 days).

Results and Discussion

Rapid chilling resulted in a faster temperature decline than conventional chilling ($P \leq 0.0001$; results not shown). Carcasses in rapid chilling attained 2.6 °C after 24 hours as compared with 3.5 °C for those in conventional chilling. After 48 hours, carcass temperature had decreased by one additional degree for both chilling regimes. The post mortem fall of loin pH was similar with both chilling systems., but the effect of electrical stimulation was substantial. As expected, ES carcasses had pH values significantly lower than those of NS carcasses during the first 24 hours of chilling ($p \leq 0.0001$). All carcasses, independent of stimulation treatment, attained similar values (pH = 5.47) after 48 hours ($P>0.05$; results not shown). Carcass weight losses were significantly reduced ($P<0.05$) with rapid chilling (Figure 1).

In Québec, approximately 5% of grain-fed veal carcasses are graded A1, 70% A2, 20% A3 and less than 1% A4. Reflectance measurements taken on the brisket of NS carcasses at 48 hours represent the results of the official grading procedure. Table 1 shows that the grades obtained from NS carcasses in this study were close to the distribution of the commercial grain-fed veal population in Québec, although there was a greater proportion of carcasses that graded A2 at the expense of A3 carcasses. Early grading (i.e. at 24 hours) on the brisket of NS carcasses proved unsatisfactory as only 10% of carcasses placed in the first two quality grades. ES significantly improved the 24 hour brisket grade distribution in comparison with NS carcasses. In this muscle, however, the effect of time on colour was more significant than the effect of treatment (Figure 2). Consequently, measurements at 48 hrs on the briskets of NS carcasses, which is the official grading procedure, produced better grade distributions than measurement on either NS or ES carcasses at 24 hrs. However, after 48 hrs, the reflectance of the meat was better with ES than with NS carcasses. Thus the best grading results from measurements at the brisket were obtained with ES carcasses after 48 hours (Table 1).

When reflectance was measured on the loin, the distribution of grades was dramatically improved in comparison with the results obtained on the brisket (Table 2). With the actual payment grid, veal producers get a similar price for carcasses in either A1 or A2 grades. Therefore, the results of the grading would be acceptable if measurements were made on the loin as early as 24 hours post mortem, with or without ES. The ES treatment had much more effect on the loin than on the brisket and produced much better grading results in comparison with the grades obtained on NS loins (Table 2). Even at 24 hours, ES loins gave better grades than NS loins at 48 hours.

Colour measurement in the center of the longissimus muscle, which is more glycolytic and larger than the darker and more superficial pectoralis muscle, could account for these results. ES is known to be more effective in more glycolytic muscles. In this study, the mean weight of skinned carcasses was < 353 pounds and there was no effect of the chilling regime on grade distribution. Therefore, the stability of reflectance measurements between 24 and 48 hours suggests that the full post mortem glycolytic process had taken place within the longissimus muscle under our experimental conditions. Figure 3 shows that the reflectance measured on the loin at both 24 and 48 hours reflect the grade obtained after up to 5 days post mortem. The paler appearance of electrically

stimulated veal would enhance the acceptability of the product and make a favourable marketing argument.

Conclusion

Commercial veal carcasses are not split into fore- and hindquarters. Therefore the loin is unavailable for grading. However, our experiment has shown that with the type of carcasses used in this study, grading could be carried out as early as 24 hours if reflectance was measured on the loin. Based on the actual payment grid, ES would not bring additional advantage to the producer. However, the grid could be adjusted to take into account the colour of the longissimus muscle. The advantage of using ES would then be apparent since its effect on the improvement of the reflectance of the loin was maintained after up to five days. Use of ES would also allow a faster turnover of carcasses in the plants and would reduce carcass moisture losses.

Table 1. Distribution of grades of electrically stimulated (S) and non-stimulated (NS) veal carcasses as determined by reflectance measurements on the brisket

	Carcass Grade			
Grading time, and treatment	A1	A2	A3	A4
24h S	2.5%	32.5	60	5
24h NS	0	10.3	87.2	2.6
48h S	20.0	77.5	2.5	0.0
48h NS	7.7	87.2	5.1	0.0

Table 2: Distribution of grades of electrically stimulated (S) and non-stimulated (NS) veal carcasses as determined by reflectance measurements on the loin

	Carcass Grade			
Grading time, and treatment	A1	A2	A3	A4
24h S	85%	15	0	0
24h NS	28.2	71.8	0	0
48h S	87.5	12.5	0	0
48h NS	43.6	56.4	0	0

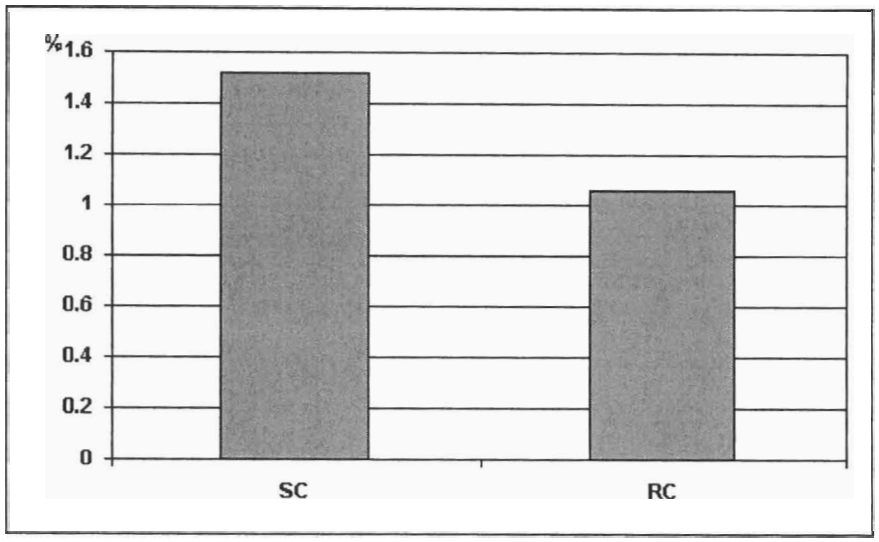

Figure 1: Weight losses of veal carcasses resulting from slow (SC) or rapid (RC) chilling.

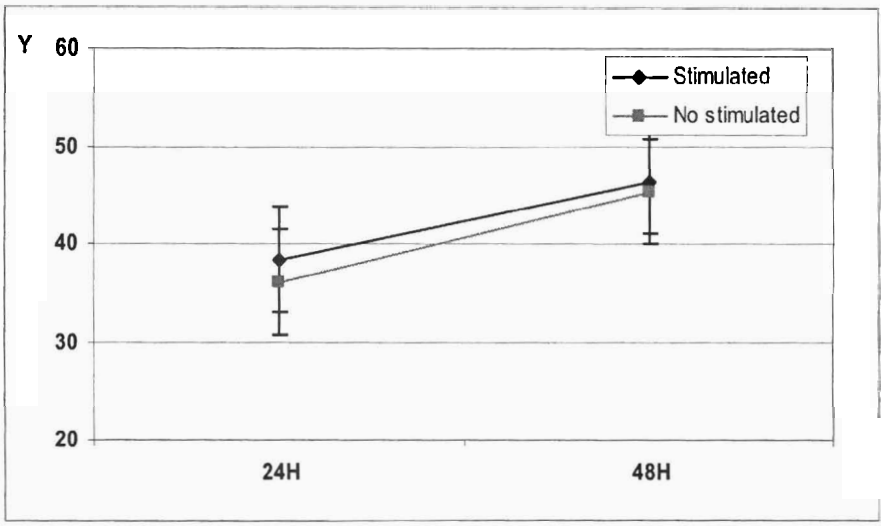

Figure 2: Reflectance values in veal pectoralis muscle with or without electrical stimulation.

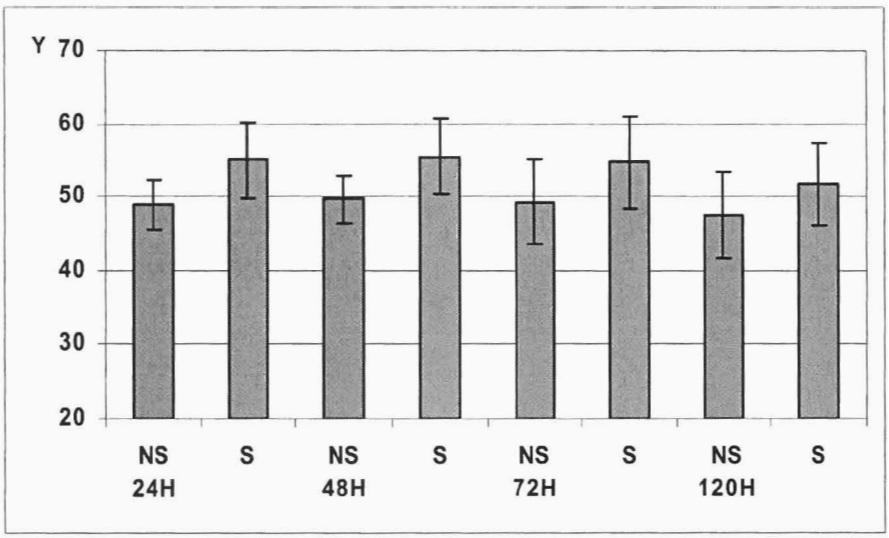

Figure 3: Reflectance values of electrically stimulated (S) or non-stimulated (NS) veal longissimus muscle at different times after slaughter.