INSTRUMENTAL COLOR CLASSIFICATION OF VEAL CARCASSES

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Background.

Color is a major determinant in pricing carcasses of milk-fed veal calves. Classification of veal carcasses into 10 different color classes is currently carried out by visual assessment of the rectus abdominis muscle with the use of a specially developed color scale (Hulsegge et al., 1996). The Dutch veal industry is interested in an on-line instrumental method to determine the color of veal, provided that the results of an instrumental method produce a similar outcome as the currently used ten-point color scale. Different instruments have been tested for on-line measurement of veal color (Eikelenboom, et al., 1992, Becherel, et al., 1992). Earlier results showed that measurement with the Minolta CR300 might be suitable for providing an objective on-line assessment of veal carcass color (Becherel, et al. 1992, Denoyelle and Berny, 1999). However, the Minolta CR300 was mostly tested under experimental conditions. Its capacity to distinguish between the currently used ten color classes in the Netherlands is not known.

Objective.

The aim of this experiment was to test the use of the Minolta Chromameter CR-300 as an objective color classification method of veal carcasses for the replacement of the current visual assessment into 10 color classes under practical conditions.

Methods.

Visual and instrumental color assessments were carried at two slaughter days in two commercial slaughter plants in The Netherlands. A total of 955 carcasses were measured at 45 min post-mortem. Carcass color was assessed visually by three experienced graders using a color scale according to current Dutch classification standards (scale from 1 (light) to 10 (dark)) (Hulsegge et al., 1996). Surface muscle color was measured by means of two Minolta Chromameters (Minolta, type CR-110, Japan, light source D65) on the rectus abdominis (RA) muscle after having taken aside the covering fascia. Formula were developed with the use of a discriminant analysis method (Morrison, 1976) to predict the visually assessed color class by Minolta CIELAB values. All correlations presented are Spearman correlations. Data were analysed with the Genstat 5 statistical program. A pilot software program was developed to measure carcass class based on these formula. Color measurements were carried out under practical conditions in two different slaughterhouses over a period of nine weeks. A total of 50156 veal carcasses were measured.

Results and discussion.

The correlation's between Minolta L* values and visual color assessment are in the range of –0.72 to –0.77. These results are comparable with earlier research, which visually classified carcasses into only 5 color classes (Becherel et al., 1992). The results between the three graders ranged from 0.84 to 0.88. The mean color class scores for their visual assessments were 5.7 ± 1.3, 5.9 ± 1.2, and 5.8 ± 1.2 for observers 1, 2, and 3 respectively. The three graders assigned 49.6% of the carcasses to the same color class. In 47.3% of the carcasses there was a difference of one class higher or lower, and in 3 % a difference of two or more classes were present between the three observers. No carcasses were assigned to color class 1 and only a few to class two (0.2 %). The average of the three observers and the two Minolta devices were used in the discriminant analysis. Results of the discriminant analysis are shown in table 1. No formula was developed for class 1 since no class 1 carcasses were visually assessed during this phase. The best combination of color parameters in classification functions was formed by using L* and and a* values, their squared, and their product terms. In this way 63.2 % of the carcasses was assigned similar to the visually assessed carcass color.

Table 1 Percentage correctly assigned veal carcasses based on different combinations of L^*, a^* and b^* values in discriminant rules.

Combinations:		$[L^*]$	$[L^*, a^*]$	$[L^*, a^*, b^*]$	$[L^*, a^*, L^*a^*, L^{*2}, a^{*2}]$	$[L^*, a^*, b^*, L^*a^*, L^*b^*, a^*b^*, L^{*2}, a^{*2}, b^{*2}]$
Class	n	% correctly classified carcasses				
2	2	100.0	100.0	50.0	100.0	100.0
3	15	33.3	66.7	53.3	66.7	53.3
4	90	42.2	62.2	60.0	62.2	57.7
5	283	42.0	55.5	56.5	56.9	56.9
6	370	50.5	62.4	62.7	72.1	72.4
7	126	51.6	63.5	63.4	65.1	65.1
8	33	33.3	39.4	45.5	42.4	42.4
9	28	21.4	32.1	35.7	25.0	28.6
10	8	75.0	75.0	62.5	62.5	62.5
Total	955	45.9	59.1	59.2	63.2	62.8

The mean color class of the large scale visual assessment and instrumental color measurements were similar for both slaughterhouses (5.91 ± 1.13 and 5.96 ± 1.23, respectively). The results of the visual assessment compared to the results of the instrumental color measurements are shown in Table 2 (carcasses assigned to color class 1 were omitted). The Minolta and the observers assigned 50.2% of the carcasses to the same color class. For 19.2% of the carcasses Minolta classified one color class lighter, and for 23.1% one color class darker than the observer. The results were comparable for both slaughterhouses. However, it appeared that there were differences in observed percentages between days.

Table 2. Percentage carcasses for the differences in assigned color classes between instrumental (Minolta) and visual color classification, as determined in slaughterhouse A (4 weeks; n=23999) and B (5 weeks; n=26157).

		Percentage carcasses						
		Difference in determined color class between Minolta and visual classification						
Slaughterhouse A								
		-3	-2	-1	0	1	2	3
Week	1	1.2	4.4	27.0	47.6	16.4	2.7	0.7
	2	1.0	2.1	20.6	48.2	21.6	4.3	2.1
	3	1.2	2.5	16.7	51.6	22.7	4.0	1.2
	4	1.8	2.7	17.0	50.0	24.1	3.4	1.0
	total	1.3	2.9	20.3	49.4	21.3	3.5	1.2
Slaughterhouse B								
Week	5	0.7	2.5	20.9	50.7	21.9	2.9	0.6
	6	0.5	1.8	15.2	50.1	27.4	4.1	0.7
	7	0.3	1.1	13.0	51.1	29.8	4.1	0.6
	8	0.3	2.3	19.8	51.0	23.9	2.4	0.3
	9	0.3	2.8	25.3	51.9	17.7	1.5	0.4
	Total	0.4	2.0	18.2	50.9	24.8	3.2	0.6
total A + B		0.8	2.5	19.2	50.2	23.1	3.3	0.8

Discriminant analysis in this experiment yielded new discriminant rules. When the new rules were applied to the data, classification results using L^* and a^* values and their squared and product terms matched the visual colour classification in 49.3% of the carcasses (Table 3). In practice differences between slaughter houses might influence the visual observation. This type of variation can be reduced by the use of a Minolta colorometer.

Table 3. Percentage correctly classified veal carcasses based on the use of $L^*, a^*, L^* * a, L^{*2}, a^{*2}$ in discriminant rules.

Class	n	% correctly classified carcasses
1	17	76.5
2	49	22.5
3	417	31.5
4	3531	35.1
5	14676	45.2
6	17858	54.1
7	9902	42.7
8	2840	31.4
9	633	21.6
10	233	53.7
Total	50156	49.3

Conclusions.

By using discriminant rules, the Minolta CR300 shows an acceptable accuracy for prediction of veal color classes, as determined with the currently used ten-point color scale in practice in The Netherlands. Practical considerations will determine the extent to which this on-line method will be implemented in practice.

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