OBJECTIVE MEASUREMENT OF VEAL COLOR FOR CLASSIFICATION PURPOSES

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INTRODUCTION

The veal color is an important quality trait and takes part in the carcass price. At present, in France, evaluation of veal color for classification purposes is done subjectivly, at the end of slaughterline, using different people, different muscles, different illumination conditions, ... This classification is based on the EC-system with 4 classes from 1 (« white ») to 4 (« red »). This method is often the cause of commercial conflicts. Then, there is an urgent need in practice (for meat processing) to supplement the EC-system of classification with an objective system of measurement of veal color.
Becherel et al. (1991) compared 5 instruments on 367 veals (the Minolta chromameter CR300, the Sensoptic colorimeter, the reflectometer Retrolux III and 2 optical fibres from Sensoptic and from the Danish Meat Research Institute), as to their predictive value for veal color with a visual assesment from 4 trained people. The results showed that the Minolta chromameter CR300 was the best instrument to predict the veal color classification.
Since 1991, new instruments have been developed, for example the Minolta chromameter CR310 which is different from the CR300 by the surface of measurement (CR300 : diameter 5 mm, CR310 : 50 mm).
The purpose of this study was to compare chromameters CR300 and CR310 to predict the veal color at the end of slaughterline (around 45 min post mortem).

MATERIALS AND METHODS

2300 veal carcasses were used. Visual assesment and instrumental measurements were used, at the end of slaughterline, on the right *Rectus abdominis,* on the external side and skin having been removed. Carcasses were independently judged by 3 trained persons according to the EC-system of classification (1 : white, 2 : light pinkish, 3 : pinkish, 4 : red). Previous sessions were held to train the 3 persons and to control their repeatability and their reproducibility.
The instrumental measurements were performed with the chromameters CR300 and CR310 using the D65 lightsource and the CIELAB values (L*, a*, b*). For each veal carcass, 3 measurements were taken on 3 differents places on the surface of the muscle.
Multiple stepwise regression analysis was carried out by SAS (1988), between the EC-classification (score from 1 to 4) and L*, a*, b* values. Finally, equations of prediction were developped with 80% of carcasses and tested with the 20% left. Two samples were used for this test. The first one corresponded to the total sample S1 (2300 carcasses), the second S2 (1651 carcasses) corresponded to a part of the sample where the 3 persons had done the same visual color score for the same carcass.
Performances of chromameters were estimated by the R^2 value and the percentage of carcasses correctly graded. This percentage represented carcasses whose the score predicted by the chromameter corresponded to the score given by visual assesment.

RESULTS AND DISCUSSION

Carcass characteristics are given in **table 1**. Carcasses are unequally distributed in the different color grades : score 1 = 8 % , score 2 = 55.5 %, score 3 = 32.1 % and score 4 = 4.4 %.
The results of multiple regression are presented in **table 2**. Ten differents models (M1 to M10) are studied (5 per chromameter). When the same values are considered, correlations are higher for CR310 than for CR300 : 8 points between M3 and M8, 5 points between M5 and M10. R^2 value reaches 70% with the CR300 and 75% for the CR310. CR300 appeared less suitable than CR310 to predict the veal color.
The better results obtained with the CR310 could be explained by the surface of meat measured. With 5 cm of diameter, this measurement could be more representative of the veal color as it is perceived with a visual assesment.
Models M5 and M10 are selected to develop and to test equations of prediction. **Table 3** and **4** shows the results of carcasses well graded with 10 different drawing lots on the 2 samples (S1 and S2). With S1 75.9% carcasses are well graded with the CR300 and 80.8% with the CR310. With

Table 1 : Carcass characteristics (n = 2300)

	Mean	S.D.	Minimum	Maximum
Carcass weight (kg)	120.65	16.35	54.8	183.3
Conformation score	0+ (9.3)	2.12	P (5)	E (17)
Fat score	3 (7.7)	0.90	1 (2)	4 (11)

S.D. : standard deviation

Table 2 : Multiple stepwise regression between instrumental measurements and visual assesment

CR300		CR310	
Values	R^2	Values	R^2
a * (M1)	0.47	L* (M6)	0.67
a *, b * (M2)	0.59	L*, b* (M7)	0.73
a *, b *, L * (M3)	**0.68**	**L*, b*, a* (M8)**	**0.74**
a*, b*, L*, L^{2*} (M4)	0.69	L*, b*, a*, L^{2*} (M9)	0.74
a*, b*, L*, L^{2*}, b^{2*} (M5)	**0.70**	**L*, b*, a*, L^{2*}, b^2 (M10)**	**0.75**

S2, 82.4% carcasses are well graded with the CR300 and 87.6% with the CR310. The difference between S1 and S2 could be explained with a better determination of the limits of color classes. Finally, this test confirms the superiority of the CR310 to predict the veal color, but this superiority is low, so the use of CR300 is still possible.

Table 3 : Test of models M5 and M10 with S1 (2300 carcasses)

	carcasses correctly graded (%)	
Number	CR 300	CR 310
1	78.0	83.5
2	74.8	79.0
3	77.9	80.5
4	74.7	78.5
5	74.8	82.2
6	74.0	81.0
7	75.3	81.2
8	78.2	84.9
9	77.2	79.5
10	74.6	78.5
Mean	**75.9**	**80.8**

Table 4 : Test of models M5 and M10 with S2 (1650 carcasses)

	carcasses correctly graded (%)	
Number	CR 300	CR 310
1	81.5	89.6
2	80.2	86.4
3	85.2	85.5
4	82.5	86.9
5	83.2	89.0
6	79.1	88.0
7	81.4	83.8
8	84.7	91.2
9	82.1	86.9
10	84.3	88.9
Mean	**82.4**	**87.6**

CONCLUSION

These results suggest that it should be possible to predict the veal color classification on the slaughterline. Two solutions are conceivable.

First, the color score could be computed by means of equations of prediction :

- For the CR300, the equation is : color score = -0.675(L*) + 0.173 (a*) - 0.188 (b*) + 0.006 (L^{*2}) + 0.008 (b^{*2}) + 18.850
- For the CR310, the equation is : color score = - 0.753 (L*) - 0.277 (b*) + 0.006 (L^{*2}) + 0.003 (a^{*2}) + 0.02 (L^{*2}) + 23.560

This solution gives a result immediatly and could be interface with a computer to print a ticket, with the weight, the conformation score, the fat score and the color class.

Second, this solution consist in taking the more representative values (L* and a* for CR300 and L* and b* for CR310) and in building an abacus. The operator measures the color with a chromameter and looks for the correspondance between the L*a*b* values and the color class.

The result is less accurate than previously but could be used immediatly in the slaughterhouse.

Finally, the chromameter CR310 (and CR300) could be used in slaughterhouse to predict the veal color according to the EC-classification system. However, further investigations are probably necessary to improve the accuracy, especially for the extreme color classes (1 and 4), and to consolidate the equations of prediction.

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REFERENCES

BECHEREL F., 1991. [European Project : Test of different instruments to measure the color veal on slaughterline]. Report, Ed. CIV.

CASSENS R.G., DEMEYER D., EIKELENBOOM G., HONIKEL K.O., JOHANSSON G., NIELSEN T., RENERRE M., RICHARDSON I., SAKATA R., 1995. Recommendation of référence for assesment of meat color. 41st Annual International Congress of Meat Science and Technology.

EIKELENBOOM G., 1989. The assesment of veal color for classification purposes. 35th Annual International Congress of Meat Science and Technology.

LEGRAS P., 1978. [Veal color assesment]. Couleurs, n°100.

RENERRE M., 1981. [Meat color and its measurement], Viandes et Produits Carnés, vol 2 (5).

SAS Institute INC. - 1988. SAS/STAT user's guide, release 6.03 editiion. SAS Institute Inc., Cary, NC, USA.