

Two new tools for classifying veal meat color in France : the interprofessional 5 classes color scale and the chromameter

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Abstract - Colour, one of the main features of meat veal, plays a key role in carcass pricing. Currently, veal meat colour classification is visually made according to a colour scale with 4 classes. Some differences between this reference and slaughterhouses classification exist. Given this context, the veal sector has decided to modify the current colour scale by inserting an intermediate class between classes 2 and 3. Some tests, conducted in 4 slaughterhouses, have permitted to develop this new colour scale with 5 classes, to assess these new classifying rules in real conditions, and to calibrate the chromameter (colour measurement instrument) with this future reference. The 5 classes colour scale, validated by the entire veal sector and FranceAgriMer, appeared relevant and chromameter classifying performances were as good, even better, than those obtained with the current 4 classes classification. Thus, the veal industry has two new tools for objectively classifying veal meat colour in the current context : the 5 classes colour scale, and the chromameter calibrated with this new reference. Before field use, the veal chain has to engage official homologation of these tools with control institutions.

Keywords - Veal - meat color - classifying

I. INTRODUCTION

Colour is an important feature of veal meat, which plays a key role in carcass pricing. Currently, the only method for determining this colour is a visual scoring reference consisting of 4 classes, as defined by the French *Office de l'Élevage* (Office of Livestock) [1]. Subjective in nature, this scoring reference is likely to vary between slaughterhouses and can be a possible source of dispute. For that reason, the French sector has been working on this topic for nearly 20 years, with the objective of making classification consistent on a national level. Various studies [2] [3] [4] have shown that it is possible to objectively reproduce a visual assessment using colour measuring devices, under experimental conditions but more specifically,

under true conditions in the slaughterline. The last study [4] has shown that considerable differences were observed between the FranceAgriMer (formerly the Office of Livestock) scoring system and that utilised by slaughterhouse operators. These differences mainly fall between classes 2 and 3. Given this assessment, the profession has decided to modify the current reference by inserting a new intermediate class between classes 2 and 3, thereby creating a new 5 class reference. The *Institut de l'Élevage* (French Livestock Institute) was asked to develop this new colour scale and to test its suitability in the industry. These tests [5] also enabled the calibration of the chromameter, the colour measuring device seen to be dependable for estimating visual classification, with this future reference.

II. MATERIALS AND METHODS

All of these tests were carried out by a panel of experts, independent of the slaughterhouses (3 FranceAgriMer inspectors and 1 technician from the French Livestock Institute) in order to ensure objectivity in the classification.

A. Scoring synchronisation

Prior to testing under true conditions, the 4 experts synchronised their results with the current 4 class reference and developed a new 5 class reference for classification, with the following rules:

- The steaks considered intermediate between the current classes 2 and 3, i.e. posing a problem when scoring, were classified in the newly created class, scored 2 on the future colour scale,
- The steaks that could clearly be allocated as class 2 or 3, i.e. clearly a “real 2” or a “real 3”, were scored in the current classes 2 or 3, scored in 1 and 3 respectively on the future colour scale,

- The steaks belonging to the current classes 1 and 4 were classified in the same classes, scored 0 and 4 respectively on the future colour scale.

B. Slaughterhouse tests

Tests were carried out in 4 slaughterhouses chosen due to being representative of all the veal categories slaughtered in France, particularly milk-fed veal. For each slaughterhouse, over 4 days per slaughterhouse, the measurements taken for each carcass were:

- Scoring made by the slaughterhouse scorer and by a technician from the French Livestock Institute, according to the current 4 class reference,
- Individual scoring made by 3 FranceAgriMer inspectors, according to the new classification rules for the 5 class reference,
- Colour measurements with the chromameter (Minolta CR410 with illuminant D⁶⁵) made by an operator from the French Livestock Institute at the end of the slaughterline

These tests involved more than 5300 carcasses. Given the subjectivity involved in individual decisions and the new 5 class reference, it was decided to validate the suitability of the new colour scale and to calibrate the chromameter on a consensual sample, i.e. on the carcasses scored identically by the 3 scoring experts from FranceAgriMer. This involved 3395 carcasses, or 63.8% of the total number tested.

C. Development of the new colour scale

The profession decided to modify all of the colours on the current colour scale, in addition to adding the intermediate class. The 4 panel experts were appointed to define the 5 colours for the new colour scale based on several resins recreating the texture of pork (“Japanese colour scale”) or veal meat (palette) with colour ranking from off-white/pinkish to dark red/brown.

During the tests carried out in the slaughterhouses, the expert panel compared all of these resins with the various colours observed in fresh steaks at the end of the slaughterline. Among these resins, the 4 experts unanimously chose the 5 most representative shades of veal found in each colour class. A steering committee comprising all the professionals involved (Interveaux, representatives from all the federations in the sector, slaughterhouse classifiers, FranceAgriMer) were then called together at the slaughterhouse to view these colours, validate them, and discuss the other points

concerning the colour scale. All of these choices confirmed by the steering committee were officially validated by the interprofessional bureau (Interveaux) and FranceAgriMer.

D. Chromameter calibration

Relationship intensity between the measurement parameters (L^* , a^* , b^*) and the visual scoring in 5 classes was estimated by calculating the R^2 determinant coefficient. Predictive equations were calculated based on the consensual sample by cross validation according to discriminant analysis with *a priori* recognition of veal proportions in each of the 5 classes. This method provides an equation by class of colour on a validated mathematic model [3]. These equations then enable the calculation of the probability of affiliation of the sample measured for each of the 5 classes, the sample being assigned to the class for which its probability is highest.

II. RESULTS AND DISCUSSION

A. Features of the new colour scale

The new colour scale will comprise 5 different slabs of colour, with the texture of a veal steak, and will be assembled to form a colour scale all together (Fig.1). Table 1 shows new classes designation and scoring.



Fig. 1 : Shades representing the 5 classes

Table 1 Class scoring and designation

Current colour scale with 4 classes				
1	2	3	4	
White	Light pinkish	Pinkish	Red	
Futur colour scale with 5 classes				
0	1	2	3	4
White	Very light pinkish	Light pinkish	pinkish	Red

B. Testing the New 5 Class Reference Rules in the Slaughterhouses

Veal distribution among the classes: It differs according to the classification method (Table 2). It can be said that veal proportions between the expert scoring in 4 classes and 5 classes match very well. With the 5 class reference, more than half of the veal samples are classified in the new intermediate class. In accordance with previous results [4], consequent classification difference was found in classes 2 and 3 between the expert and the slaughterhouse classifications. The distributions by slaughterhouses confirm these observations and show the differences between the slaughterhouses with regards to the differences in the numbers of calves slaughtered.

Table 2 Distribution (%) of veal among the classes

Classification (n=3395)	class 1 futur 0	class 2 futur 1	class 3 futur 2	class 4 futur 3	class 5 futur 4
FranceAgriMer	1,3	13,0	51,3	24,9	9,5
Office	1,9	38,7	-	50,4	9,0
CR-410	1,5	52,8	-	39,5	6,1
Slaughterhouse	2,6	70,0	-	18,0	9,4

Panel performance for the 5 class reference: 2-2 concordance among the panel's scoring classifications varies between 69.5% and 91.2% depending on the person scoring and the slaughterhouse, with an average between 74 and 78.9% for all sites combined. These performances are very good as they are higher than those observed during the formation of these scores (an average of 67.9%), and the same as previously [4] for the panel with 4 classes (an average of 72 to 78%). Furthermore, discordant veal is also distributed among the classes and corresponds to 20 to 30% of the total number. This confirms that the scorers have less difficulty in classifying veal among the various classes with the introduction of the new class.

Concordance between scoring in 5 classes and expert scoring in 4 classes: There is concordance when assigning a carcass to one of the 5 new classes, respecting the classification rules defined, namely:

- Carcasses 0 in 5 classes were scored 1 in 4 classes
- Carcasses 1 in 5 classes were scored 2 in 4 classes
- Carcasses 2 in 5 classes were scored 2 or 3 in 4 classes
- Carcasses 3 in 5 classes were scored 3 in 4 classes
- Carcasses 4 in 5 classes were scored 4 in 4 classes

Concordance between classifications with the 5 class reference and the expert's classifications with the 4 class reference varies between 87.3 and 95.9%, with an average of 92.6% for all sites combined. This confirms the good concordance between the 2 classification references. Few differences can be observed between the slaughterhouses and the discrepancies are generally balanced in terms of their severity (underestimated scoring equivalent to overestimated scoring). The extreme classes were the most affected, particularly future class 0. Distribution of the current classes into the future classes (Table 3) enabled specification of the differences: 40 and 25% of veal currently classified in classes 1 and 4 respectively do not appear in the corresponding future classes. This is probably due to the low numbers in these classes and so the scorer's lack of practice. For the new class, concordance is very good with almost 100% of the veal in this class scored 2 or 3 in the 4 class reference, and with the same proportions. All of these results validate the suitability of the 5 class reference from the current reference, which is the 4 class Office reference.

Table 3 Distribution (%) of the current class in the futures classes

5 classes * 4 classes	n	futur 0	futur 1	futur 2	futur 3	futur 4
n total	3393	44	439	1742	846	322
class 1	65	56,9	38,5	4,6	0	0
class 2	1312	0,5	31,2	65,0	3,3	0
class 3	1711	0	0,3	51,7	42,6	5,4
class 4	304	0	0	0	24,3	75,7

Calibration of the chromameter: the R^2 obtained in the 4 slaughterhouses between the scores in 5 classes and the L^* , a^* , and b^* measured are very satisfactory and even better than the R^2 optimum obtained previously for the 4 class classification [4]. This reflects a strong relationship between instrumental measurements and 5 class colour scoring. Classification according to the newly defined rules does not, therefore, affect the scoring prediction potential of the chromameter.

Percentage of veal correctly classified in 5 classes with predictive equations developed: in the 3395 veal samples representing the total sample, 68.3% were correctly classified by the predictive equations. Among the discrepancies, 54.6% of veal samples were affected in the lower classes (lighter), meaning that that the prediction is slightly less strict than the FranceAgriMer panel's visual classification. That

being the case, it could be considered that the misallocations were broadly balanced. The percentage of veal samples that were concordant by class between the 5 class visual classification and the predicted scores (Table 4) is comparable, even better for the extreme classes, to that previously obtained under similar conditions with the current 4 class colour scale [4]. These results confirm the ability of chromameters to reproduce the visual classification according to the new 5 class reference rules. Finally, the distribution of veal samples per class by predicted scoring is only slightly different from the distribution actually observed with visual scoring (Table 5).

Table 4 Percentage of concordant veal samples by class between visual classification taken as a reference and the predicted scores developed by predictive equations

Visual score * predicted score		class 1 futur 0	class 2 futur 1	class 3 futur 2	class 4 futur 3	class 5 futur 4	% total
Office 4 classes	n	4	2105	-	1334	195	3638
	(1)	50	70	-	70	36	68
	(2)	0	87	-	55	0	71
FAM 5 classes	n	44	440	1743	846	322	3395
	(3)	65,9	48,6	84,2	51,5	53,1	68,3

(1) with the équations from Lopez [6]

(2) with the équations from Evrat Georgel [4]

(3) with the équations from Evrat Georgel [5]

Table 5 Class distribution of veal samples observed and predicted

	Futur 0	Futur 1	Futur 2	Futur 3	Futur 4
n total	44	440	1773	846	322
%	1,3	13,0	51,3	24,9	9,5
n total predicted	46	314	2026	764	245
% predicted	1,4	9,3	59,7	22,5	7,2

III. CONCLUSION

A new colour scale enabling the classification of veal meat, comprising 5 classes, has been developed and validated by the entire veal sector and FranceAgriMer. It will be a scale comprising 5 slabs of colour, with the texture and sheen of a veal steak. The shades of each slab, characteristic of the middle of each class, will correspond to the shades of the 5 resins chosen by the experts. The designation of the 5 classes will be imprinted on the scale, with the classes ranging from 0 to 4 (white to red) and the new class introduced being class 2 (light pinkish). To date, the supplier of the colour scale has been chosen following

a call for tender, issued by the interprofession. Meanwhile, slaughterhouse tests have enabled the validation, in true conditions, of the suitability of the new classification rules for 5 classes. The performances were very good, but the implementation of new classification in the industry will require training for scorers to adapt to this 5 class colour scale. Finally, these tests have enabled the collection of chromameter measurements for carcasses scored according to the new rules of 5 class classification. The analysis of concordances obtained with predictive equations between the 5 class expert scoring and the predicted scoring confirmed the ability of chromameter to reproduce visual classification. In all the slaughterhouses, the number of veal samples correctly classified are comparable to, even better than, those observed with the 4 class reference. The chromameter may now be calibrated using the new 5 class reference and can give reliable, objective and consistent results among the slaughterhouses, provided it is used in defined conditions. It is now the responsibility of the interprofession to seek approval from the authorities for the use of this semi-automatic tool as an alternative to visual classification.

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REFERENCES

1. Journal Officiel, 1976 Arrêté du 8 juin, JO du 1^{er} juillet
2. Denoyelle C., 2001 Institut de l'Élevage, report n°201322
3. Hulsegge B., Engel B., Buist W., Merkus G.S., Klont R.E., 2001. Meat Science, 57, 191-195
4. Evrat Georgel C., 2006 Institut de l'Élevage, report n°170632016
5. Evrat Georgel C., 2010 Institut de l'Élevage, report n°001032009
6. Lopez C., 2005 Institut de l'Élevage, not published, in [4]