USE OF DIFFERENT METHODS TO ASSESS VEAL COLOUR AND PIGMENT CONTENT

G. EIKELENBOOM, W. ZHANG, A.H. HOVING-BOLINK, G.J. GARSSEN AND P. STERRENBURG
DLO-Research Institute for Animal Production, Zeist, The Netherlands

SUMMARY

Using 60 veal carcasses, colour was determined at 30-40 minutes post mortem by assigning colour scores with a colour standard and measuring L*(lightness)-, a*(redness)- and b*(yellowness)-values of the M. rectus abdominis (RA). Colour (L*-, a*- and b*-values) of the Mm. longissimus dorsi (LD) and semimembranosus (SM) was measured on a freshly cut surface, after vacuum-packing for 7 days. Also, ultimate pH was assessed and pigment content was determined in triplicate with both the Hornsey and the Nit409 method.

Both in LD and SM the Nit409 method resulted in a significantly higher pigment content, than the Hornsey method. The Nit409 method showed a considerably better repeatability and also a better relationship with the colour measurements of the same muscle, than the Hornsey method. In the LD, pigment content and a*-values were significantly lower than in the SM.

Pigment content, as assessed with the Nit409 method, was better related to the a*- than to the L*- and b*-values, while the reverse was true for ultimate pH. Because of the relatively large influence of variation in scatter due to variation in ultimate pH, it is concluded that early post mortem is the most appropriate time to evaluate veal colour, as it is influenced by absorption (pigment content) and conditions in primary production. Early post mortem measurement of veal colour (RA) was better related to ultimate veal colour, than the visual evaluation using a colour standard.

INTRODUCTION

In the veal industry, meat colour is an important quality criterion. In practice, veal colour is frequently judged visually at classification (30-40 min post mortem), when meatiness and fatness of the carcass are also evaluated. LEGRAS(1981) investigated the colour of a large number of veal muscles and recommended the use of a colour standard to evaluate the colour of the M. rectus abdominis (RA). In the Netherlands a colour standard has been developed for classification purposes and is currently applied in practice to the RA (STERRENBURG, 1990). There is, however, a need for further objectivity by using instruments for surface or invasive measurement of veal colour (EIKELENBOOM et al., 1992) at the time of classification. In some studies conducted in this field, ultimate meat colour and/or pigment content have been used as a reference (EIKELENBOOM et al, 1989; BECHEREL et al., 1992).

For the assessment of pigment content in muscle various methods exist: the cyanomet method (DRABKIN et al. 1950), the Hornsey method (HORNSEY, 1956), the method described by KRZYWICKI (1982) and the alkaline haematin method (KARLSSON and LUNDSTROM, 1988). The latter authors discussed the advantages and disadvantages of these methods. Recently, TROUT (1991) compared various methods in pork muscle and developed a modification of the alkaline haematin method: the Nit409 method. With this method the absorption of the muscle extract was measured in the Soret band (409 nm) after oxidation of the pigments to metmyoglobin with sodium nitrite. He suggested that, in pig muscle, the Nit409 method has the same accuracy as the Hornsey, cyanomet and Krzywicki method, but is more accurate than the alkaline haematin method (TROUT, 1991).

The purpose of this study was to compare the classical Hornsey method with the Nit409 method in veal longissimus and semimembranosus muscle and to study their relationship with the ultimate (7 days post mortem) colour of the same muscles, as well as the early post mortem colour of the RA muscle.

MATERIAL AND METHODS

A total of 60 male veal calves from the Dutch Black and White breed, involved in a growth study with repartitioning agents (GARSSEN et al., 1992) were used for the experiment. All animals were individually housed at the Institute's experimental farm and fed a commercial milk replacing diet for 24 weeks, with or without ß-agonists from week 21 onwards (Garssen et al., 1992). The animals were slaughtered at a mean live weight of 238.1 ± 7.5 kg at the institute's slaughter facility. No electrical stimulation was used and carcasses were subjected to normal chilling procedures (3 °C, air speed 1.5 m/sec). At 30-40 min post mortem (p.m.) the colour of the left M. rectus abdominis (RA) was visually judged by two persons, using a colour standard (STERRENBURG, 1990). The RA was then removed from the carcass and immediately measured in triplicate with the Hunter Labscan (lightsource: D65; standard observer 10°; illumination and measuring aperture 44 and 50 mm, respectively).

At 24 hr p.m. samples of the Mm. longissimus dorsi (LD; 11th rib) and semimembranosus (SM) were removed from the left carcass side and vacuum-packed. At 7 days p.m. the packs were opened and the samples portioned. Immediately after portioning L*-, a*- and b*-values were immediately measured in triplicate (Hunter Labscan, D65, 10°, illumination and measuring aperture 17 and 30 mm, respectively). Approx. 100 gram was frozen and kept at -25 ° C, until analysis of pigment content. After thawing, the pH was measured (Ingold-electrode Lot 406). Muscle samples were freed from fat and connective tissue and finely minced. A total of six samples was taken from the minced meat for triplicate analysis of pigment content with both the Hornsey (1956) and the Nit409 method (TROUT, 1991). Absorbance of the extracts was measured using a Shimadzu UV-200 double beam spectrophotometer. With the Hornsey method the concentration of 'total pigment' in the muscle is measured as mg haematin per kg meat. In order to convert this to mg pigment (myoglobin) per g, as with the Nit409 method, a factor 17,500/616,5 x 1000 was used (TROUT, personal communication).

Routine statistical procedures were applied for analysis of data (SPSS-X and Genstat 5)

RESULTS AND DISCUSSION

Table 1 presents the mean values of all observations. Judged from the colour score, veal colour was relatively light. Unlike in previous experiments (EIKELENBOOM et al., 1989, 1992) and (unpublished) data from practice, carcasses with colour standard class 4 and 5 were not present. This lower variability in colour might have influenced the relationships discussed later.

It should be noted that the L*(lightness)-values at 7 days post mortem did not significantly (t-test) differ for the longissimus (LD) and semimembranosus (SM) muscles, while the a*(redness)-value and pigment content were significantly ($p < .001$) lower for the LD (Table 1). These differences between muscles may be explained from differences in their fibre type-distribution.

Mean values for pigment content found in both muscles with the Nit409 method were significantly ($p < .001$) higher than for the Hornsey method. These results are not in agreement with those of TROUT (1991), who found that for pork the Hornsey method resulted in a significantly higher pigment content. He suggested, therefore, that the Hornsey method is more effective in extracting haem-pigments from muscle.

The repeatibility of the analysis of pigment content in the triplicate samples of minced meat, was for the Hornsey method .54 and .52 in LD and SM muscle, respectively. With the Nit409 method these values were .86 and .83, respectively, which indicates that this method is much more accurate. TROUT (1991) suggested that the accuracy and precision of the Nit409 method was similar to the Hornsey method, but better than the alkaline haematin method.

In table 2 the simple correlations are reported between and among the measurements made on the M. rectus abdominis (RA), LD and SM. Both in LD and SM the Nit 409 method was better related to the colour measurements at 7 days post mortem, than the Hornsey method. This is another indication that the Nit409-method is more accurate. Although the Nit method is in our experience faster, it is more laborious than the Hornsey-method.

Within both muscles (LD and SM) the pigment content as assessed with the Nit409 method, is better related to the a*-values than the L*- and b* (yellowness)-values. In contrast, the ultimate pH is better related to the L*- and b*-than to the a*-values. In the SM but not in the LD, a significant ($p<.01$) correlation ($r = .32$ for SM) was found between pigment-content (Nit409-method) and ultimate-pH. From the regression analysis it appeared that pH alone accounted for 50 and 55 % and pH and pigment content (Nit409) combined for 63 and 72 % of the variation in L*-value of LD and SM, respectively. Our results suggest that there is in veal a considerable influence of ultimate pH , and probably rate of pH-fall (not measured), on ultimate veal colour, in particular L*- and b*-values, due to the resulting variation in scatter.

Hunter colour measurements of the RA at 30-40 min post mortem, were in general better related to ultimate meat colour (LD and SM) at 7 days post mortem than the visual assessment of the colour of RA (table 2). Because of the relatively large influence of ultimate pH on the L*-value of LD and SM, the L*-value of the RA explained 36 and 49 % of the variation in pigment content (Nit409) of LD and SM, respectively, while the L*-values of the latter muscles explained only 18 and 39 % of the variation in their pigment content. Therefore, these observations suggest that in veal the time of classification is the most appropriate moment to evaluate meat colour, as it is influenced by production conditions on the farm.

CONCLUSIONS

The Nit409 method has a better repeatability than the Hornsey-method, although it is more laborious. Also, the Nit409 method shows a better relationship with the meat colour of the same muscle, than the Hornsey method.

Ultimate veal colour (in particular L*(lightness)- and b*(yellowness)-values) is considerably influenced by variation in scatter, due to variation in ultimate pH. Therefore, the early (30-40 min) post mortem period is the most appropriate moment to evaluate veal colour, as it is influenced by absorption (pigment content). Early post mortem objective measurements of veal colour on m. rectus abdominis, were better related to ultimate meat colour than the visual evaluation of the colour of the RA, using a colour standard.

REFERENCES

BECHEREL F., EIKELENBOOM G., RENERRE M., ANDERSEN J.R., 1992. Contribution 38th ICOMST, Clermond Ferrand.

DRABKIN D.L., 1950. J. Biol. Chem. 182, 317-333.

EIKELENBOOM G., VAN DER WAL P.G., KAUFFMAN R.G., STERRENBURG P., SCHNEIJDENBERG T.C.H.G.P., 1989. Proc. 35th ICOMST, Roskilde, Denmark, p. 220-222.

EIKELENBOOM G., HOVING-BOLINK A.H., HULSEGGE B., 1992. Meat Sci. 31, 343-349.

GARSSEN G.J., HOVINK-BOLINK A.H., VERPLANKE J.C., 1992. Contribution 38th ICOMST, Clermond Ferrand.

HORNSEY H.C., 1956. J. Sci. Food Agric. 7, 534-540.

KARLSSON A., LUNDSTROM K., 1988. Proc. 34th ICOMST, Brisbane, Australia, p. 285-287.

KRZYWICKI K., 1982. Meat Sci. 7, 29-34.

LEGRAS P., 1981. Viandes et Produits Carnés 2, 17-23.

STERRENBURG P.,1990. Ontwikkeling kleurenstandaard kalfsvleeskleuren. IVO_DLO Rapport B-363 (with English summary). Research Institute for Animal Production, Zeist, The Netherlands.

TROUT G.R., 1991. Proc. 37th ICOMST, Kulmbach, Germany, p. 1198-1201.

Table 1. Results (mean ± Sd) of measurements in veal Rectus Abdominis (RA), Longissimus Dorsi (LD) and Semimembranosus (SM) muscles.

	RA	LD	SM	
Visual colour score (scale 1-5); 30-45 min. p.m.	2.02 ± 0.75			
L*-value; 30-45 min. p.m.	46.13 ± 2.62			
a*- " " "	8.26 ± 1.08			
b*- " " "	13.22 ± 1.13			
L*-value; 7 days p.m.		58.4 ± 3.4	58.2 ± 3.8	
a*- " " "		5.4 ± 0.9	5.9 ± 1.0	***
b*- " " "		14.4 ± 0.6	14.2 ± 1.0	
Pigment content (Nit409; mg/g)		1.08 ± 0.24	1.37 ± 0.29	***
Pigment content (Hornsey; mg/g)		0.91 ± 0.18	1.11 ± 0.19	***
PH_u		5.51 ± 0.27	5.45 ± 0.15	**

***: P < 0.001
** : P < 0,01

Table 2. Simple correlations of measurements in veal muscles. Values below the diagonal are for RA an LD, values above the diagonal for RA and SM.

		RA				SM/LD					
		vis. colour	L*	a*	b*	L*	a*	b*	Nit409	Hornsey	PH_u
RA	vis. colour	-	-.67	.60	-.50	-.40	.57	-.20	.58	.50	.01
	L*	-.67	-	-.88	.62	.60	-.76	.35	-.70	-.49	-.20
	a*	.60	-.88	-	-.34	-.47	.66	-.26	.67	.39	.11
	b*	-.50	.62	-.34	-	.56	-.59	.39	-.42	-.15	-.33
LD/SM	L*	-.43	.60	-.51	.52	-	-.82	.78	-.63	.28	-.75
	a*	.52	-.70	.61	-.51	-.79	-	-.53	.75	.41	-.44
	b*	-.18	.26	-.19	.43	.51	-.36	-	-.44	-.18	-.83
	Nit409	.53	-.61	.57	-.29	-.44	.63	.10	-	.61	.32
	Hornsey	.21	-.29	.27	-.08	-.24	.35	-.05	.48	-	.03
	PH_u	.04	-.21	.13	-.30	-.71	.37	-.54	.30	-.12	-