COLOR MEASUREMENTS AND TENDERNESS RELATIONSHIPS IN TEN RETAIL BEEF CUTS

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BACKGROUND

One of the most important meat quality traits that influence the consumer purchasing decision is performed by appearance or color of the fresh meat. Color is used to establish the quality and acceptability of meat and meat product. The color of meat and meat products depends on the concentration of meat pigments, the chemical state of these pigments and the physical characteristics of the meat such as its light-scattering properties. The distinction between muscles is by no means clear since a continuos spectrum of properties between two extremes types of muscle can be observed (Renerre, 1990). Another important attribute to be considered is tenderness since Boleman et al. (1995) demonstrated that consumers agree to pay a premium for tender beef and Savell et al. (1992) found a strong relationship between price and tenderness within a meat cut. Researchers have been evaluating the correlation between objective measurement of meat color and tenderness trying to find a predictive variable that can be used to classify beef carcasses by tenderness (Wulf D. et al., 1997; Purchas, 1990; Picallo et al., 1998; Picallo et al., 1999; Jeremiah et al., 1991; Watanabe et al., 1995). Lacking of consistency in these results has made necessary further investigations.

OBJECTIVES:

The aim of the present work is to study the relationships among objective color measurements of retail-ready cuts and tenderness estimated by Warner Bartzler Shear Force.

METHODS

Ten retail-ready cuts of six steers of the general cattle population were sampled after 24 hours *postmortem*. These are considered the most important cuts from the market point of view. Seven cuts were obtained from the forequarter: Tenderloin: *m.psoas major* (PS), Rib Eye Steak: *m.longissimus dorsi* (LD) muscle at 10°-11° rib, Sirloin Steak: *m.gluteus medius* (GM), Round Tip: *m.quadriceps femoris* (CF), Round Eye: *m.semitendinosus* (ST), Top Round: *m.semimebranosus* (SM), Bottom Round: *m.biceps femoris* (BF) and three (3) out of them: Blade Roast: *m.triceps brachii* (TB), *m.obliquus abdominalis* (OA), *m.pectoralis superficialis* (PR). To assess objective color, a slice of 4 cm in diameter and 3 cm thick was obtained from each raw muscle, and color Hunter Lab parameters (**L**, **a**, **b**) were determined with a Colorview model 9000 Colorimeter (BYK Gardner, USA) with large view area using illuminant D_{65} (10° observer). Warner Bratzler shear force measurements (WBS) were determined in portions of 2.5 cm thick-muscle. Samples were cooked in a heated pan without oil up to 40°C of temperature measured in the geometric center of the piece, then turned to the other side and cooked until 70°C were reached (AMSA, 1978). Temperature was monitored using T-type thermocouples attached to a data logger (Fluke, Hydra model 2625). Ten cores of 1.25 cm in diameter were obtained from each cooked sample in the direction of muscle fibers and assayed for WB. Data were analyzed by Duncan's Multiple Range Test using the proc GLM and by regression analysis using proc CORR of SAS software (SAS version 6.2, Cary, 1987).

RESULTS AND DISCUSSION

Table 1 summarizes the results obtained for tenderness (WBS) and color parameters for each retail cut. WBS showed significative differences between muscles, where the most tender was the PS and the most though was PR. These results for the muscles PS, GM and PR are similar to Mc Keith et al. (1985) report. As Huffman et al. (1996) reported that consumers at home or restaurants were 98% satisfied with LD steaks that had WBS values less than 9.02 lb, the values obtained for this muscle in the present study placed in the same category. The WBS values of BF and ST muscles reported in this work are similar with those found by Shackelford et al. (1997). The WBS values for LD, PS, BF, ST, SM and GM found by Joseph et al. (1979) were higher than values presented in this work. When data were classified by the correspondence of WBS with a categoric scale (Gállinger M.M., personal communication) as are shown in Figure 1 and 2, the muscles LD, CF, GM, PS, TB can be classified as "tender"; the muscles ST y OA can be classified in "somewhat tender". The other muscles corresponded to "somewhat tough" and "tough", respectively.

The analysis of meat color parameters did not show significative differences in redness (**a** parameter) score. Yellowness (**b** parameter) shown significative differences between PS, ST and BF, GM, LD and lightness (**L** parameter) shown significative differences between different muscles. GM was assessed to be the darkest and ST was the lightest one regarding Klont et al. (1998) research. Vestergaard et al. (2000) found redness values for ST and LD similar to the reported in the present work.

When regression analysis was performed to compare tenderness with the Hunter**Lab** parameters for each muscle, the strongest coefficients were found between WBS and color parameters **a** and **b** for some muscles (Table 1). Wulf et al. (1997) and Picallo et al. (1998) found similar correlation coefficients for LD. Other muscles were assessed in this study and significative correlations were obtained for some of them.

CONCLUSIONS

Despite the low sample number used, the provided information showed for some muscles that objective tenderness and **a** and **b** color parameters had significative correlations. Even though we have obtained statistically significant results, further researches about objective meat color of different muscles would be necessary to find a simple and on-line predictor for tenderness.

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Table 1

Muscle	Mean Shear Force (lb.)*	Mean Hunter L value *	Mean Hunter a value *	Mean Hunter b value *	r ** WBS vs. L	r ** WBS vs. a	r ** WBS vs. b
PS	5.43 ± 1.02 a	29.42 ± 2.57 ab	13.07 ± 1.45 a	9.58 ± 0.99 a	ns	-0.79	ns
LD	6.30 ± 1.96 a	24.44 ± 1.87 bc	11.95 ± 2.24 a	7.36 ± 0.89 b	ns	ns	ns
GM	7.29 ± 1.09 ab	23.29 ± 1.71 e	12.52 ± 1.76 a	7.46 ± 0.84 b	ns	ns	ns
CF	7.38 ± 0.85 ab	28.40 ± 2.10 abc	12.82 ± 2.42 a	9.01 ± 1.42 ab	ns	-0.77	-0.74
TB	7.40 ± 1.56 ab	26.61 ± 1.66 bcd	12.01 ± 1.27 a	7.98 ± 0.67 ab	ns	ns	ns
OA	8.32 ± 2.06 abc	27.36 ± 2.28 bcd	12.75 ± 2.52 a	8.44 ± 1.26 ab	ns	ns	-0.88
ST	9.70 ± 1.40 bc	30.20 ± 1.67 a	12.34 ± 2.41 a	9.51 ± 1.28 a	ns	ns	ns
SM	10.32 ± 1.34 c	26.09 ± 4.09 cde	13.29 ± 3.41 a	8.55 ± 2.74 ab	ns	ns	ns
BF	10.83 ± 3.16 cd	24.48 ± 1.23 de	11.58 ± 1.51 a	7.64 ± 0.77 b	ns	0.78	0.86
PR	13.30 ± 4.91 d	26.73 ± 1.67 abc	12.22 ± 1.78 a	8.13 ± 0.28 ab	0.72	-0.72	-0.85

* different letters within the same column indicate significative differences ($p<0.05$). ** r: correlation coefficient (tenderness vs. color parameter) ($p<0.05$)

FIGURE 1: L Parameter vs. Warner Bratzler Shear Force (lb)

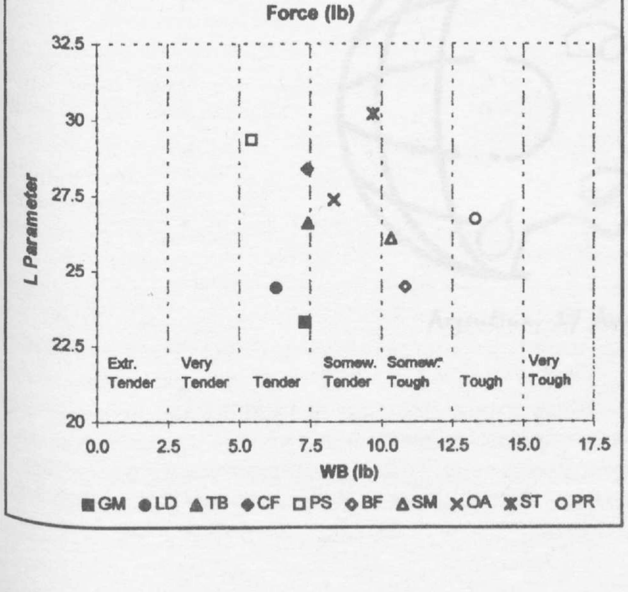

FIGURE 2: "b" Parameter vs.Warner Bratzler Shear Force (lb)