COLOR AND TENDERNESS RELATIONSHIPS IN DIFFERENT STEER BREEDS.

Picallo, A.B.; Sancho, A.M.; Margaría, C.A. and Lasta, J.A
Instituto de Tecnología de Alimentos, CICV, INTA. CC 77 (1708) Morón, Buenos Aires, Argentina.

SUMMARY

Longissimus dorsi (LD) muscle samples from 60 steers of three different phenotypes (British, Holstein and Indicus; 20 animals each) were analyzed for tenderness (Warner Bratzler shear force) and color parameters (Hunter **L**, **a**, **b**). The preliminary results shown significative differences ($p<0.05$) in tenderness among phenotypes Holstein and British vs. Indicus.

In color evaluation, parameter **a** (redness) did not show differences among phenotypes. Parameter **L** (lightness) shown significative differences ($p<0.05$) between British and Indicus and **b** (yellowness) shown significative differences among Indicus vs. Holstein and British ($p<0.05$). Significative correlations were found.

BACKGROUND

Consumers perceive meat quality through different attributes, and tenderness has been identified as one of the most important. Meat price should be in accordance with its quality and it was demonstrated that consumers agree to pay for tender beef (Boleman et al., 1995), and that there is a strong relationship between price and tenderness within a meat cut (Savell and Shackelford, 1992). Meat color is also an important meat quality attribute, physical appearance, other than leanness, is often determined solely by brightness of lean color (Jacobs et al., 1977; Berry et al., 1978). Some research were carried out to determine relationships between objective measurement of meat color and tenderness that can be used to classify beef carcasses by tenderness (Wulf D. et al., 1997; Purchas, 1990; Jeremiah, et al., 1991; Watanabe, et al., 1995). Swan et al. (1995) also found significative differences in Hunter Lab color parameters, contributing to determine meat color variability considering the country of origin.

OBJECTIVES:

The aim of the present work was to study objective beef tenderness, color and to determine if there is a correlation between them so that color measurements can be used to classify beef carcasses by tenderness. Preliminary data are shown.

METHODS

Steers (60) of three different phenotypes (British, Holstein and Indicus; 20 animals each, (ages up to six permanent teeth) of the general beef cattle population were sampled to obtain *Longissimus dorsi* (LD) muscle at 10°-11° rib after 24 hours *postmortem*. Samples were vacuum packed and frozen. All the samples were analyzed within one week after slaughter. Prior to analysis, samples were defrozen at room temperature for 24h. For Warner Bratzler shear force analysis (WBS) portions of LD muscle of 2.5cm thick were cooked in a heated pan without oil up to 40°C of temperature in the geometric center of the piece, then turned to the other side and cooked until the temperature reached 70°C (AMSA, 1978). Temperature was monitored using T-type thermocouples attached to a data logger (Fluke, Hydra model 2625). Ten cores of 1.25cm were obtained from each cooked sample in the direction of muscle fibers and assayed for WBS. For objective color evaluation, a slice of 4cm in diameter and 1cm thick was obtained from each raw LD muscle, and color Hunter Lab parameters were determined with a BYK Gardner Colorimeter (Colorview model 9000) with large view area using illuminant D_{65} (10° observer). Data were analyzed with the PROC GLM of SAS software (SAS version 6.2, Cary, 1987).

RESULTS AND DISCUSSION

Table 1 shows the results obtained for tenderness (WBS) and color parameters for each phenotype. British and Holstein phenotype are significatively different from Indicus in WBS. Regarding recent studies (Shackelford S. et al., 1997), British and Holstein animals in this study could be classified as "Guaranteed Tender" while the Indicus could be considered as "Probably Tender". Huffman et al. (1996) reported that consumers at home or restaurants were 98% satisfied with steaks that had WBS values of less than 9.02 lb. The WBS values reported in this work are coincident with those found by Wheeler et al. (1990), but higher than those reported by Wulf et al. (1997). When data were classified by the correspondence of WBS with an hedonic scale (Gallinger, M. M., personal communication) as shown in Figure 1, it can be seen that the totaly of the British (100%) can be classified as "very tender" to "tender"; only 45% Holstein in "tender" to "somewhat tender" and 15% Indicus in "somewhat tender" to "somewhat tough" reporting that the rest of the animals can be placed it within "somewhat tough" to "very tough". It must be noticed that this variability is very important when considering meat tenderness for carcass classification because this may introduce estimation errors that must be taken into account.

Meat color parameters analysis did not show significative differences in redness (**a** parameter). Parameters **L** (lightness) and **b** (yellowness) shown significative differences between Indicus vs British, and Indicus vs British and Holstein, respectively. Indicus phenotype tended to be darker (less yellow and less red) than the other two. Although it is difficult to predict meat color consumer perception by means of objective color measurements, dark meat might be considered by many consumers as low quality meat.

When regression analysis was performed to compare tenderness of each breed with the Hunter parameters (L, a, b), correlation coefficients shown in table 1 were obtained. It must be pointed out that correlation like these are available in the literature (Jeremiah et al, 1991) but they were obtained from animals of different kind (bulls, heifers, steers). In the present work , only steers were used and a significative correlation could still be obtained.

CONCLUSIONS

It can be concluded that British and Holstein phenotypes present similarities in quality attributes such as tenderness and color, and that their attributes are different from those of Indicus phenotype. Based on the results shown here, it is very important to consider the population distribution of this measurements, because they are widespread and probably assimetric.

Correlations equations might provide a rapid, costless method that can be used in attempts to predict meat tenderness probability from objective color measurements, more accurate results would be obtained when a larger number of animals could be analyzed.

LITERATURE CITED

AMSA. 1978. Guidelines for Cookery and Sensory Evaluation of Meat. Am. Meat Science Assoc., Chicago, IL.

Berry, B.W., A.L. Joseph, S.B. Wagner, T.G. Jennings, J.K. Matsushima, J. S. Brinks, J.A. Carpenter, Jr. and P.T.Fagerling, 1978. Carcass, palatability and retail charasteristics of steers and short scrotum bulls. J. Anim. Sci. 47:601.

Boleman, S.J, S.L. Boleman, J.W. Savell, R.K. Miller, R.H. Cross, T.L. Wheller, M. Koohmaraie, S.D. Shackelford, M.F. Miller, R.L. West, and D.D. Johnson. 1995. Consumer evaluation of beef of known tenderness levels. Proc. 41st Int. Congr. Meat Sci. Technol., San Antonio, TX.

Bratzler, L.J. 1932. Measuring the tenderness of meat by means of a mechanical shear. M.S. Thesis. Kansas State University, Manhattan.

Huffman et al., 1996. J Anim. Sci. 74:91

Jacobs, J.A., J.C. Miller, E.A. Sauter, A.D. Howes, A.A. Araji, T.L. Gregory, and C.E. Hurst. 1977. Bulls vs. stters. II. Palatability and retail acceptance. J Amin. Sci. 45:699.

Jeremiah, L.E., A.K.W. Tong, and L.L.Gibson. 1991 The usefulness of muscle color and pH for segregating beef carcasses into tenderness groups. Meat Sci. 30:97.

Purchas, R.W. 1990. An assessment of the role of pH differences determining the relative tenderness of meat bulls and steers. Meat Sci. 27:129.

SAS. 1987. SAST-STAT ,User's Guide. SAS Inst. Inc., Cary, NC.

Savell, J.W., and S.D. Shackelford. 1992. Significance of tenderness to the meat industry. Proc. Recip. Meat Conq. 45:43.

Shackelford S.D., T.L. Wheeler, and M. Koohmaraie. 1997. Tenderness Clasification of Beef: I Evaluation of Beef Longissimus Shear Force at 1 or 2 Days Postmortem as a predictor of Aged Beef Tenderness. J. Anim. Sci. 1997. 75:2417-2422.

Swan, J.E., V.L. Mikkelsen, W.K. Hall and A.J. Wright. 1995. Publications, Meat Industry Research Institute of New Zealand . N°950.

Watanabe, A., C.C. Daly and C.E. Devine. 1995. The effects ultimate pH of meat on tenderness changes during ageing. Meat Sci. 42:67

Wulf,D.M., S.F.O'Connor, J.D. Tatum, and G.C. Smith. 1997. Using Objetive Measures of Muscle Color to Predic Beef Longissimus Tenderness. J. Anim. Sci. 75:684.

TABLE AND FIGURES

Table 1

Phenotype	Mean Shear Force (lb)		Mean L value value		Mean Hunter a value		Mean Hunter b value		r (WBS vs L)	r (WBS vs a)	r (WBS vs b)
British	7.59 ± 0.97	a	25.64 ± 3.90	a	13.91 ± 3.28	a	9.08 ± 1.53	a	-0.49	-0.28	-0.45
Holstein	8.08 ± 1.03	a	24.84 ± 2.32	ab	14.38 ± 2.32	a	8.92 ± 1.21	a	-0.04	-0.46	-0.37
Indicus	11.67 ± 1.58	b	23.98 ± 2.61	b	12.28 ± 2.71	a	7.65 ± 1.30	b	-0.48	-0.09	-0.33

* different letters within the same column indicate significative differences (p<0.05).

Figure1: Shear Force

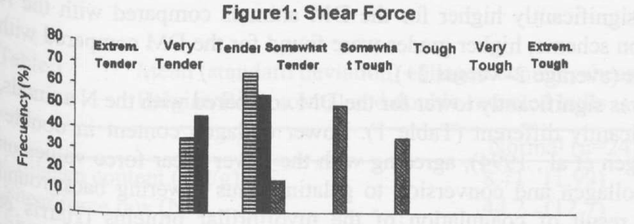

Figure 2: Hunter L value

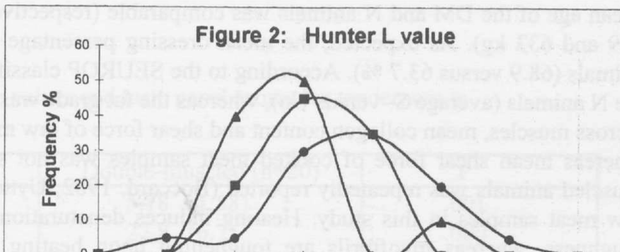

Figure 3: Hunter a value

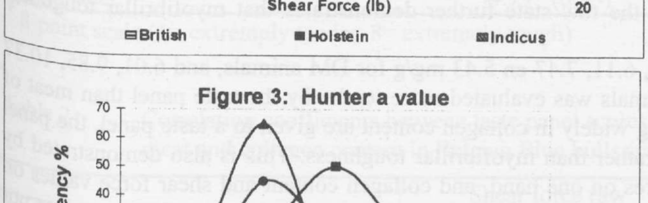

Figure 4: Hunter b value