Computer image analysis of intramuscular adipocytes and marbling in the longissimus muscle of cattle

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ABSTRACT

The deposition of fat in muscle, by consumer recognized as marbling, is an important meat quality trait. The objective of the study was to close a gap between macroscopic and microscopic marbling characteristics by means of computer image analysis (CIA). Fifty one cattle of F2 generation of German Holstein and Charolais crossbreeds at 18 mo of age were used to determine relationships among marbling traits, adipocyte size, and the amount of adipose tissue in different depots. Differences were recorded among the size of i.m. adipocytes in different groups of marbling flecks, divided according to the location in the muscle cross section and to the size of marbling flecks. The results showed positive correlation between i.m. adipocyte size and the weight of s.c. fat, intestinal fat, omental fat and perirenal fat (r = 0.50, 0.61, 0.70, and 0.63, respectively, $P < 0.001$). The i.m. adipocyte size was moderately correlated with i.m. fat content, number of marbling flecks, proportion of marbling fleck area, and total length of marbling flecks (r = 0.71, 0.44, 0.62, and 0.55, respectively, $P < 0.01$). The number of marbling flecks was also correlated with i.m. fat content, proportion of marbling fleck area, and total length of marbling flecks (r = 0.58, 0.62, and 0.91, $P < 0.01$, respectively). The ventral marbling flecks had a 5-fold larger fleck area, 4-fold more adipocytes, and also larger ($P < 0.001$) adipocytes. Larger marbling flecks contained larger ($P < 0.001$) adipocytes. Moreover, compared with the small marbling flecks, there were a 48-fold larger fleck area and 26-fold more adipocytes in the large marbling flecks. The results indicate that i.m. fat deposition increases concurrently with the other fat depots, but is still independent. Furthermore, the i.m. fat is preferentially deposited in the ventral area of LM. Although the i.m. adipocyte size has an important effect on the traits of marbling flecks, hyperplasia plays a greater role in i.m. fat deposition than hypertrophy.

Key words: Adipocytes, Cattle, Computer image analysis, Longissimus muscle, Marbling