Meat Quality Traits of *Longissimus dorsi* Muscle from Carcasses of Hanwoo Steers at Different Yield Grades

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Abstract

The strategy for increasing the palatability of Hanwoo beef through fattening could lead to a decline in yield grade. The aim of this study was to examine the meat quality traits of *Longissimus dorsi* (LD) muscle from carcasses of Hanwoo steers at different yield grades. A total of 246 Hanwoo steers was divided into the following yield grades: A (n=77), B (n=76) and C (n=93). Meat quality traits, including proximate composition, cholesterol content, nucleotide content, dipeptide content, creatine and creatinine, free amino acid content, fatty acid composition, instrumental meat color, pH, water holding capacity, drip loss, cooking loss, and sensory qualities of the LD muscle from the 3 yield grades of Hanwoo carcasses were measured. The decline in yield grade from A to C resulted in an increase in crude fat and cholesterol content as well as a decrease in inosine 5'-monophosphate and aspartic acid in the LD muscle (*p*<0.05). In terms of fatty acid composition, the LD muscle from yield grade A had higher SFA and PUFA and lower MUFA content than that from yield grade C (*p*<0.05). However, the ratio of PUFA/SFA and n-6/n-3 did not differ among LD muscles from the 3 yield grades. There were no significant differences among other meat quality traits in relation to the yield grade. In conclusion, we suggest that the changes of substances related with health and flavor can be considered in order to obtain better quality Hanwoo beef.

Key words: beef yield grade, Hanwoo steers, meat quality

Introduction

The beef grading system for cattle carcasses reveals 2 types of information: quality grade and yield grade. The principal components for determining the quality or yield grade differ somewhat by country (Polkinghorne and Thompson, 2010). The high-quality grade in the beef grading system refers to high palatability of beef in many countries, including South Korea, Australia, Canada, Japan, and the USA, but signifies high yield of lean meat in Europe and South Africa (Polkinghorne and Thompson, 2010). High palatability of beef (i.e., more tender, juicy, and flavor-intensive) can be achieved by increasing marbling (Dashdorj *et al*., 2012; Jeremiah *et al*., 2003; Kim and Lee, 2003). Therefore, marbling score is a very important factor in determining the quality grade of beef in the grading system. Many consumers who buy beef in retail stores expect high palatability and are willing to pay high prices for beef with a high quality grade (Jo *et al*., 2012).

Because of this trend, farmers of feedlot cattle commit to increasing marbling in cattle, which go through a fattening period during which they are fed concentrated feedstuffs before slaughter. Okumura *et al*. (2007) found that increasing the fattening period for Japanese Black steers from 24 to 30 mon resulted in an increase in carcase weight and intramuscular fat content of principal muscles. An increase in marbling score and the percentage of cattle graded “US Choice” was also reported by Van Koevering *et al*., (1995), who increased the feeding period of British and Continental crossbred yearling steers. However, this author found that an increase in the feeding period decreased feeding efficiency (carcase weight/feed intake). In addition, some researchers found no effect of increased fattening period of cattle on the marbling score and quality of beef (Iwamoto *et al*., 2009; Sami *et al*., 2004).
High-palatability beef is preferred by consumers in Korea. In particular, Hanwoo beef, a native Korean cattle breed, was highly preferred over beef from imported breeds because of its freshness and high quality, despite its high price (Jo et al., 2012). Hanwoo cattle generally are fed a high level of concentrated diet during the fattening period, to increase intramuscular fat (Jo et al., 2012). However, this feeding system resulted in a decline of yield grade, which could cause a reduction in income for farmers (Lee et al., 2011). Fat deposition in cattle tissue by intense fattening appeared predominantly in the subcutaneous tissue rather than in the muscle tissue (Harper and Pethick, 2004). Therefore, intense fattening of cattle, especially during the final growth stage, leads to increased thickness of back fat, which contributes greatly to a decline in yield grade (Lee et al., 2011; Moon et al., 2003). A previous study reported that the thickness of back fat had a highly negative correlation (-0.85) with yield grade, and a low positive correlation (0.15) with quality grade in Hanwoo steers (Lee et al., 2011).

From previous studies, we have learned that intense fattening of Hanwoo cattle mainly affected yield grade rather than quality grade of carcasses. However, studies of changes in yield grade and consequent differences in meat quality have not been performed. Therefore, the objective of this study was to examine the meat quality traits of *Longissimus dorsi* muscle from carcasses of Hanwoo steers at different yield grades.

**Materials and Methods**

**Animals and sample preparation**

Two-hundred and fifty Korean native cattle (Hanwoo steers, 27-30 mon old) were randomly selected from a group raised in NongHyup (Anseong). These cattle were slaughtered without electrical stimulation and cooled at 0°C for 24 h in a chilling room. Carcass weight ranged from 213 to 477 kg (average, 409 kg). The cold carcasses were graded at 24 h postmortem with the loin surface ribbed between the 13th rib and the 1st lumbar vertebrae according to the Korean carcass grading procedure (National Livestock Cooperatives Federation, 1998). In the Korean beef grading system, the yield index is obtained from 3 variables: carcass weight (kg), ribeye area (cm²), and back fat thickness (mm). Each variable has a correction factor as follows: 0.625 for back fat thickness, 0.130 for ribeye area, and 0.024 for carcass weight. In the case of Hanwoo carcasses, a compensating factor of 3.23 is added to the function for yield index (notification from MIFAFF, 2011-175).

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\text{Yield index} = 68.184 - [0.625 \times \text{back fat thickness (mm)}] \\
+ [0.130 \times \text{ribeeye area (cm}^2)] \\
- [0.024 \times \text{carcass weight (kg)}] + 3.23
\]

Yield grade was scored by criteria revised as of January 2013

- A grade (yield index ≥ 67.20)
- B grade (67.20 < yield index ≥ 63.30)
- C grade (yield index < 63.30)

Of the 250 Hanwoo steers, 4 had a yield grade that was a step up or down in the grader's opinion, and were eliminated from the sample set for this study. The *Longissimus dorsi* (LD) muscles at the 14th-18th vertebrae were removed and transferred to the laboratory. After aging for 7 d at 4°C, the subcutaneous and intermuscular fat and visible connective tissues of LD muscles were trimmed and used to analyze meat composition and quality parameters.

**Proximate composition**

The proximate composition of the LD muscles was determined by a slight modification of the AOAC (1995) method. Moisture content was obtained by drying 3 g of samples placed in aluminum dishes for 15 h at 104°C. Crude protein content was measured by the Kjeldahl method (VAPO45, Gerhardt Ltd., Germany). The amount of nitrogen obtained was multiplied by 6.25 to calculate crude protein contents. Crude fat contents were measured by the Soxhlet extraction system (TT 12/A, Gerhardt Ltd., Germany). Crude ash content was measured by burning 2 g of samples overnight in a furnace at 600°C.

**Nucleotides**

The meat samples (5 g) were mixed with 25 mL of 0.7 M perchloric acid and homogenized (T25b, Ika Works (Asia), Sdn, Bhd, Malaysia) for 1 min at 1,130 g to extract nucleic acids. The extracted nucleic acids were centrifuged (Union 32R, Hanil Co., Ltd., Korea) for 15 min at 2,090 g (4°C) and filtered through Whatman No. 4 filter paper (Whatman Inc., England). The supernatant was then adjusted to pH 7 with 5 N KOH (SevenEasy, Mettler-Toledo Int. Inc., Switzerland). The pH-adjusted supernatant was placed in a volumetric flask and adjusted to a volume of 100 mL with 0.7 M perchloric acid (pH 7). After 30 min of cooling, the mixture was centrifuged (Union 32R) at 2,090 g (4°C) and the supernatant was filtered through a 0.2-μm PVDF syringe filter (Whatman). The