INTRODUCTION OF CARCASS IMPROVEMENT TECHNOLOGY
UTILIZING CARCASS IMAGE DATABASE

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ABSTRACT

In Japan, marbling in the beef rib eye is an extremely important economic trait, the difference of carcass unit price is more than doubled depending on the degree of Beef Marbling Standard (BMS) number in the carcass auction market. Evaluation of marbling is carried out by a grader with excellent skill belonging to the Japanese Meat Grading Association. However, grading is performed macroscopically. For example, the degree of fine marbling is considered in BMS judgment but not recorded. We analyzed rib eye image from carcass cross section in detail by image analysis method and developed a carcass image database which consolidated these data. More than 50,000 data from 2005 have been accumulated in this database, mainly on Japanese Black, Crossbred (Japanese Black x Holstein), Japanese Brown, which are traded on the carcass market in Hokkaido. The recorded data in this database are production information (birth date, breeding farmer, fattening farmer and fattening days), carcass grading information (carcass weight, rib eye area, BMS number, meat color), carcass market information (unit price, carcass price), pedigree information (sire, maternal grand sire) and image analysis traits (intramuscular fat % in the ribeye: IMF %, coarseness index, new fineness index). The new fineness index (NFI) is a score utilizing the circumference length of all marbling, and the score becomes higher as the meat reaches its finer marbling phase. The BMS number in Japan is evaluated by a combination of IMF % and NFI. The carcass image database also has an advanced search function. For example, by combining sire and maternal grand sire, it is possible to instantaneously search and display what the meat quality will be. By using the image analysis trait, meat quality can be evaluated more objectively. By using our new carcass camera, rib eye digital image is transferred to the carcass image database at the same time of photographing. Practical use of this system will contribute further to the improvement of beef cattle in Japan.

Keywords: Beef Marbling Standard (BMS), image analysis

INTRODUCTION

In Japan, Wagyu is composed of Japanese Black (JB), Japanese Brown, Japanese Shorthorn, and Japanese Polled. JB cattle were exported to the United States from Japan in the 1990s and cattle derived from these JB form the genetic base for WAGYU cattle now produced by countries outside of Japan. Recently, we developed an objective evaluation system including camera, software, and novel indicators for judging the marbling attributes and other beef quality attributes using high-resolution images of the cross section of the beef carcass (Kuchida et al. 2006). Hamasaki et al. (2006) in utilizing our image analysis methods reported that camera marbling percentage is the single largest contributing factor to the BMS No in JB. There is evidence that the marbling particle size, both larger particle size (coarseness) and smaller marbling particle size (fineness) in the longissimus muscle affects the final carcass unit price in the JB cattle (Takeo et al. 2016). Although there are many researches using our image analysis in the JB in Japan (Kato et al. 2014; Nakahashi et al. 2007; Nakahashi et al. 2008; Okamoto et al. 2003; Osawa et al. 2008). Kuchida and Kanai (2012) developed a methodology to determine Japanese Beef Marbling Standard number by the combination between intramuscular fat percent and the shape of marbling which quantified with new fineness index by computer image analysis.

On the other hand, it is very important for fattening farmers to look back on the production situation such as the amount of feed, pedigree information by viewing carcass image data. We also developed the image database for beef
General incorporated association Meat Image Japan (MIJ) is established in 2014 by authors. The purpose of this association is to expand our image analysis technology for beef carcass to commercial base or global carcass evaluation. The aim of present study is to introduce our MIJ carcass image database system.

MATERIALS AND METHODS

Data and traits

The carcass grading traits and image analysis traits were collected from over 50,000 Japanese Black, Japanese Brown, Japanese Shorthorn, Crossbred and Holstein from 2005 to 2015 in Hokkaido. Carcass grading records were carcass weight, rib eye area, rib thickness, subcutaneous fat thickness, yield estimate score, beef marbling standard number, beef color standard number, firmness and texture, beef fat standard number and so on. For the image analysis traits, cross section images of carcass were taken by using the mirror type camera (HK-333; Hayasaka Rikoh, Sapporo, Japan). The image analysis values were calculated using a dedicated image analysis software (BeefAnalyzer-G: CS solution, Sapporo city). The image analysis traits were rib-eye area (REA), camera marbling percent (CM%), coarseness index of marbling (CIM), and new fineness index (NFI). The REA defined as the area of longissimus thoracis muscle. The trait was calculated from (number of pixels in rib-eye area)/(number of pixels in 1 cm)2. The CM% was defined as the proportion of marbling fat in longissimus thoracis muscle. The CIM indicated the proportion of coarse (larger) marbling particles in the longissimus thoracis muscle. Thus, higher values of CIM are found in carcasses with larger proportions of large marbling particles. The NFI showed the degree of fine (smaller) marbling particles in longissimus thoracis muscle (Kuchida and Kanai 2012). Thus, higher NFI indicates the muscle has a large number of small marbling particles.

MIJ carcass image database was installed in the cloud system. All carcass grading traits, image analysis traits, production history including breeding farmer information and pedigree information were stored in the MIJ carcass image database.

RESULTS AND DISCUSSION

All carcass grading records, digital image data for carcass cross section and image analysis traits can be searched and browsed. The top page of carcass image database after login by administrator was shown in Fig. 2. Excessive subcutaneous fat would lower the production efficiency. Of course, amount of subcutaneous fat can be judged from the grading record, however, the clear and stable digital image of carcass cross section might be more effective information for understanding quality and quantity traits and be a better reference for the next production. For example,
Fig. 3 is demonstrating a comparison for the difference of intermuscular fat and subcutaneous fat level. We can recognize the excessive levels of fat in Fig.3-(b). Also, from the information of carcass grading record for Beef Marbling Standard, we cannot recognize the fineness of marbling. The fineness of marbling is very important as well as the amount of marbling for the grading. For example, if the marbling which was assigned as "BMS number 8" cannot be known the marbling detail from only grading record. Digital image and its analyzed values would be a great information to convey the degree of marbling for carcass market section, animal breeding program, feeding trial and so on. Fig. 4-(a) shows the statistical information of the combination of sire and maternal grand sire (MGS). In addition, Fig. 4-(b) shows a carcass cross-sectional image produced by specific sire x MGS combination. By sharing this information with breeding farmer and fattening farmer, selection of sire for their owned female or mating program would become effective and strategic.

Fig. 3. High (a) and poor (b) yield carcass.

Fig. 4. Statistics (a) for carcass grading records and image analysis traits of progenies by mating combination (Sire x Maternal grand sire) and carcass images (b) from specific mating (Sire A and MGS B)
REFERENCES


