PREDICTING CARCASS MEAT QUALITY GRADE BY ULTRASOUND IN HANWOO (KOREAN NATIVE CATTLE)

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Background

Real-time ultrasound instruments have been widely used in the field for estimating live animal BFT, LMA and IF (Song et al., 2002). Recently, several institutions and organizations have developed software systems, that can predict percentage of intramuscular fat or marbling from real time ultrasound images. However, limited information has been published on the accuracy or precision of these systems (Brethour, 1994; Herring et al., 1998). Since 1993, the Korean Animal Products Grading Service has provided a beef grading system for quantifying meat yield and quality factors by subjective evaluation. The ability to use ultrasound to precisely and accurately estimate carcass measurements in live animals should be of benefit to the beef industry, allowing it to move away from the current practice of pricing cattle on pen averages to a value-based marketing system. Ultrasonic speckle deposits were related to the degree of marbling. Skilled sonographers can visually interpret an echogram and estimate marbling in a live animal with fair accuracy.

Objective

The objective of this study was to evaluate ultrasound measurements before slaughter for improvement of prediction meat quality grade.

Methods

Sixty six progeny testing of Hanwoo steers were ultrasonically scanned by Super-eye Meat (FHK Co. Ltd., Japan) with the electric linear probe (2 MHz frequency: 27 X 147 mm) on the left side of 13th rib nearly one week before carcass for estimating marbling score. Scanogram were obtained using double frame display capabilities of the equipment, and a transducer guide was used to minimize error that might occur due to animal back line curvature and the overlapping step required to produce one complete image of the longissimus muscle. The resulting ultrasound images were recorded on portable personal computer and later viewed on a display monitor to determine marbling score estimates. Ultrasonic meat quality grade were predicted by standard ultrasonic image (Fig. 1). Meat quality index were visually and corresponded subjectively to the 5-point classification scheme presented in Fig. 2. This provided a visual estimate of the gray-level co-occurrence matrix or the spatial interdependencies between image elements. The rib, which served as a densimeter, was completely affected at the highest speckle score because attenuation of the sound beam traversing an area that contained substantial marbling precluded enough wave energy reaching the bone to register its image.

The decision trees that have too many nodes has a probability that has large forecasting error when it is applied for new data. Thus, inappropriate branch should be removed from decision tree formed, and the decision tree that has sub-tree structure was decided as find forecasting model.

Results and Discussion

Prediction accuracy of meat quality grade by standard ultrasonic image is presented in Table 1. Prediction accuracy of meat quality grade was showed 78.8%.

Distribution pattern of meat quality grade by the decision tree method and prediction accuracy meat quality grade by ultrasonic meat quality index are presented in Fig. 3 and Table 2, respectively. The decision tree method employed 5-point classification scheme as target parameters. From the results of decision tree method using ultrasonic meat quality index, 87.5% of ultrasonic images both 1st or 2nd level of Index B and Index D were allocated to quality grade 1+, 57.1% of ultrasonic images with 1st or 2nd level of Index E and Index D and with 3rd to 5th level of Index B were quality grade 1. However, 93.5% of ultrasonic image with 3rd to 5th level of Index E and with 2nd to 5th level of Index D, also with 2nd to 4th level of Index D were allocated to quality grade 2. 100% of ultrasonic image both 3rd to 5th level of Index E and 5th level of Index D were quality 3. It was found that the marbling score was mainly influenced by the distinctness of rib on ultrasound image. Prediction accuracy of meat quality grade by ultrasonic meat quality index was 86.4%, resulting in 7.6% higher accuracy than that by standard ultrasonic image.

Conclusions

The result of this research with image texture suggested that interfacing a computer with an ultrasound system should improve accuracy and precision of the procedure. Such technology would be a useful tool as well as a predicting method in mechanical meat grading.

Pertinent literature

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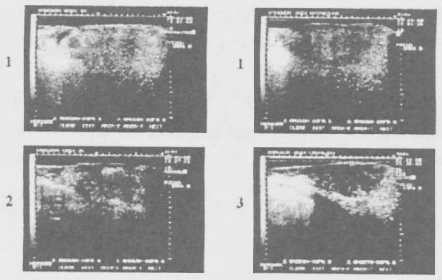

Fig. 1. Standard ultrasonic image

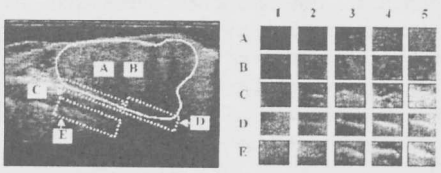

Fig. 2. Standard image of ultrasonic meat quality index

Table 1. Prediction accuracy of meat quality grade by standard ultrasonic image

QGC[1]	QGU[2]				Total	Accuracy (%)
	1+	1	2	3		
1+	12	5	0	0	17	70.6
1	1	9	6	0	16	56.3
2	0	2	29	0	31	93.5
3	0	0	0	2	2	100.0
Total	13	16	35	2	66	78.8

[1] Carcass meat quality grade, [2] Ultrasonic meat quality grade.

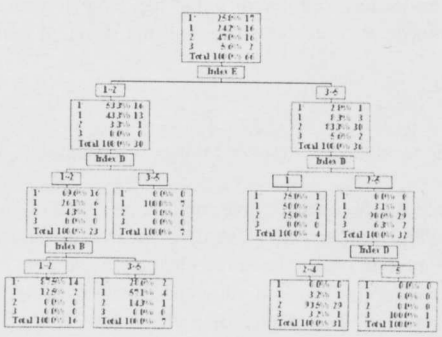

Fig. 3. Distribution pattern of meat quality grade by the decision tree method

Table 2. Prediction accuracy of meat quality grade by ultrasonic meat quality index

QGC	QGU				Total	Accuracy (%)
	1+	1	2	3		
1+	14	3	0	0	17	82.4
1	2	13	1	0	16	81.3
2	0	2	29	0	31	93.5
3	0	0	1	1	2	50.0
Total	16	18	31	1	66	86.4