

ACCURACY OF MEASUREMENT VALUES FROM MIJ-CAMERA SYSTEM FOR BEEF GRADING OF JAPANESE BLACK IN JAPANESE ABATTOIR

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I. INTRODUCTION

Beef carcass grades in Japan are determined by the Japanese Meat Grading Association accredited carcass graders. Objective measurement of carcass characteristics plays an important role for genetic improvement and fattening strategies of beef cattle. In recent years, several researchers reported that the size of intramuscular fat deposition (fine marbling) was closely associated with the price of the carcass¹, and the palatability of beef, particularly in shabu-shabu cooking methods², increases as the fine marbling score increased. Currently, the mirror type camera was used to obtain high resolution digital images of the rib eye area of beef cattle. However, because of the size, weight and handling procedures, the mirror type camera was not suitable for commercial use at abattoirs. Therefore, a new generation of camera for beef carcass evaluation has been developed by Meat Image Japan (MIJ). The aim of this study was i) to investigate the feasibility of the MIJ camera system in the Japanese abattoirs and ii) to examine the accuracy of measurement values of the MIJ-camera compared to the mirror type camera and grading records.

II. MATERIALS AND METHODS

In this study, 182 Japanese Black and crossbred cattle carcasses were evaluated using a MIJ-30 camera. Carcass ID number was collected by scanning the carcass barcode tags. A beak was attached to the MIJ-30 camera. As the result of a beak kept in close contact with the rib eye cross section, the angle of MIJ-30 camera was maintained at 30 degrees. Captured digital images were exported to a carcass image cloud data system which was developed by MIJ. The rib eye muscle area of the carcass was automatically extracted and was analysed. The following carcass characteristics were analysed; rib eye muscle area, intramuscular fat deposition (IMF%), meat colour (luminance of lean), coarseness index and new fineness index (NFI). Same carcass were photographed by mirror type camera. The image analysis traits of the MIJ camera, of the mirror type camera and grading records of the carcass graders were evaluated and compared. The BMS number of carcass grades was predicted by analysing digital image traits of MIJ-30 camera and the accuracy of measurement values of the camera was examined.



Figure 1. MIJ-30 type carcass camera

III. RESULTS AND DISCUSSION

Product specification and performance of MIJ-30 camera and the mirror type camera was shown in Table 1. The weight of MIJ-30 including battery is 2.6kg and was lighter than that of the mirror type camera. The

time stamp of first image was at 0931 and that of last image (183rd) was at 1022. Research outcomes indicated that MIJ-30 camera could take more than 200 digital images per hour. The required computing time including rib eye extraction and calculation for image analysis traits was within 10-15 seconds after capturing the digital images. Correlation coefficients among MIJ-30 camera, the mirror type camera and carcass grading records for image analysis traits were shown in Table 2. The equation for prediction of the BMS number by analysing image traits of MIJ-30 camera was described below;

$$\text{BMS} = 37.64 \times \text{IMF}\%^2 - 20.05 \times \text{IMF}\% + 0.050 \times \text{NFI} + 2.65 \quad (R^2 = 0.933)$$

Percentage of the difference between the BMS evaluated by the grader and the predicted value within ± 1 was 97.3%. This result was better than Kuchida et al.³ From this research, MIJ-30 might be a better grading tool for objective measurement of beef meat quality.

Table 1 Product specification and performance of MIJ-30 and mirror type camera

Item	MIJ-30	Mirror type camera (HK-333)
Body size	48 x 15 x 33 cm	62 x 51 x 31 cm
Weight	2.6 kg	8.3kg without external battery
Imaging area	15 x 20 cm	30 x 37 cm (A3 type)
Maximum photographing number per hour	200-300	200
Battery retention time	1.5 h	1.0 h
Rib eye extraction	Auto	Manual
Automatic calculation time	10-15 sec	N/A

Table 2 Correlation coefficient among MIJ-30 camera, mirror type camera and carcass grading records for image analysis traits

	Rib eye area	IMF%	Luminance of lean	NFI
MIJ-30 vs Mirror type camera	0.952	0.993	0.855	0.954
MIJ-30 vs Grading records	0.964	0.926 (vs BMS)	-0.563 (vs BCS)	—

BMS: Beef Marbling Standard, BCS: Beef Color Standard

Table 3 Predicted BMS number by analysing image traits of MIJ-30 camera

Difference ^a	n	%
-2	2	1.1%
-1	38	20.8%
0	110	60.1%
1	30	16.4%
2	3	1.6%

^a : Predicted BMS - Graded BMS

IV. CONCLUSION

This research outcome indicated that MIJ-30 camera is able to achieve high accuracy carcass data and it can be easily applied in standard operation procedures at commercial abattoirs.

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