BEEF CLASSIFICATION CENTRE

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Introduction

The industrial version of an objective system for beef carcass classification (BCC) is likely to become available this year. The production engineering and final testing of the prototype is progressing at the moment.

BCC is a semi-automatic system, which with one operative can measure the beef carcass composition and EUROP conformation and fatness. The measuring system includes a video image analysis subsystem, a reflection probe measuring device and an electronic weighing system. Based on the experience with the pre-prototype of the BCC it was reported by Sørensen et al. (1988) that the BCC has the following RSD-values predicted by multiple regression equations:

- saleable meat 1.5%

- fat trim 1.4%

- bone content 1.3%

- EUROP conformation 1.0 subclass

- EUROP fatness 0.6 class

The output of the prototype of the BCC includes an index for muscularity and an index for the value of the carcass based on the results of the carcass composition determination.

The production engineering and final testing of the prototype is based on the experience with the pre-prototype which was tested in 1987. It includes both mechanical and electronic engineering modifications. The system concept for the BCC pre-prototype and prototype is the same.

The BCC is developed by the Danish Meat Research Institute and the project, which started in 1983, is likely to be finalized with the availability of a commercial system this year. A brief description of the project history is:

1983-1985	Method studies
1985	Search for VIA subsystem
1986-1987	Development and test of pre-prototype
1988-1989	Development and test of prototype

The project has been supported financially by the Danish Livestock and Meat Board, the Council of Technology and by the Development Foundation.

BCC concept

The BCC is installed after the meat inspection on the slaughterline. The BCC principle is shown in Figure 1.
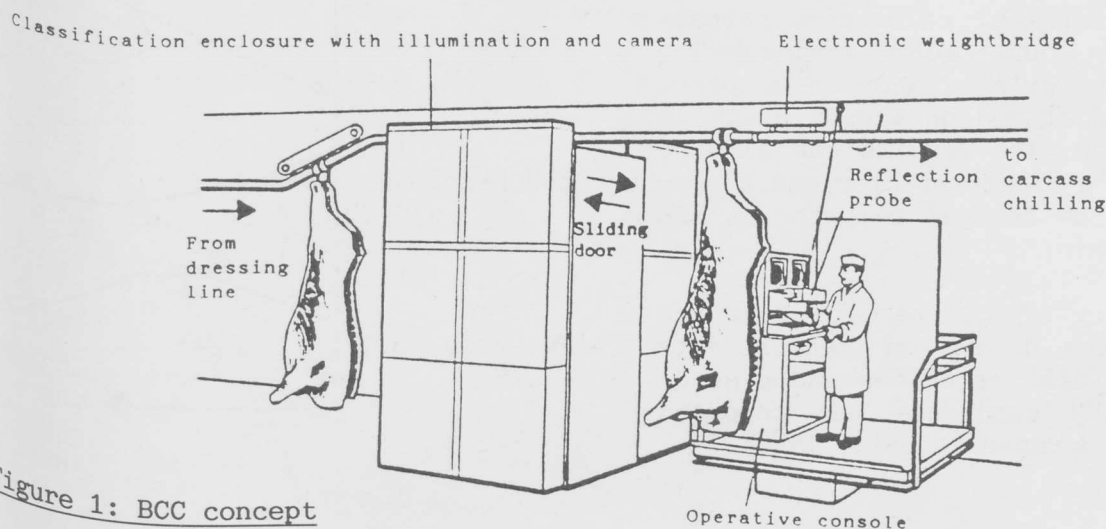

Figure 1: BCC concept

The first fully automatic operation includes transportation of a complete carcass or the first half of a split carcass to the centre of the "light-box", positioning of the carcass lateral to a black and white CCD camera, which is positioned approx. 3 m from the surface of the carcass. The carcass is lit from behind in order to establish the carcass contour. Measurements of the carcass length, and several carcass widths, of the tail root position, of the carcass area and the curvation of the thigh are made by a computer equipped with a framegrabber. The carcass surface is then illuminated from the front with green light in order to achieve a good dicrimination between fat and lean areas and to measure the fat cover as a percentage of the total area.

The second BCC operation includes automatic weighing of the hot carcass, measurement of fat cover thickness at the rump 10 cm laterally from the tail on both left and right carcass sides, measurement of fat cover thickness over the longissimus dorsi muscle and of the thickness of the longissimus dorsi muscle and uses a manually operated reflection probe for the thickness measurements.

The BCC operative also enters codes for killing sequence number, category and EUROP colour on the terminal keyboard.

Based on carcass category, hot weight and on whether the carcass is split or not, the microcomputer placed in the operative terminal calculates carcass composition and EUROP-grades. The results are printed out on a paper printer and stored on floppy discs in the computer. The results can also be printed on a ticket printer and transmitted to the central computer at the slaughterhouse.

The accuracy of the results from the pre-prototype based on measurements from 2,948 beef carcasses and dissection of 389 carcasses was reported earlier by Sørensen et al. (1988).
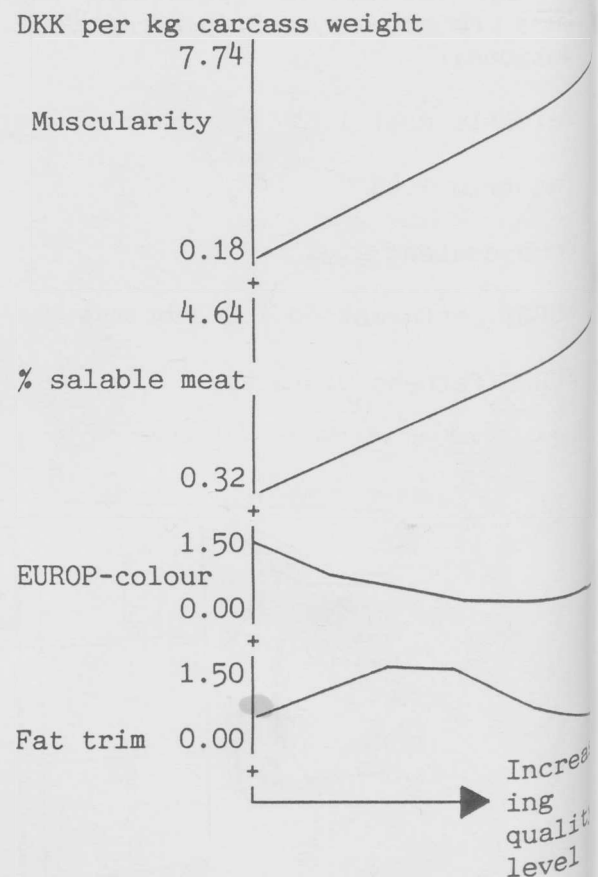
The VIA-system has been described by Petersen et al. (1987) and details about the Danish optical probe was reported by Nielsen et al. (1984).

In addition to the algorithms for calculating carcass composition and EUROP-grades mentioned above the BCC is equipped with algorithms for the calculation of a muscularity index and a value index.

The muscularity is an index based on the weights of 6 muscles from the hindquarter and the area of the longissimus dorsi muscle, both corrected for carcass weight.

The average is determined to be 100 with a standard deviation of 10, based on the above mentioned material. The R^2 is 0.66 and the RSD-value is 5.5 for predicting the index.

The value index is calculated on the basis of partial commercial value of the carcass composition, the muscularity, and the EUROP-classification of fat/lean colour as described below.

DKK per kg carcass weight

7.74

Muscularity

0.18

+

4.64

% salable meat

0.32

+

1.50

EUROP-colour

0.00

+

1.50

Fat trim   0.00

+

Increasing quality level

The value index can furthermore be used directly as the basis for the payment for the animal.

BCC modes of operation

The main task for BCC is objective measurements of beef carcasses but BCC also includes the following modes of operations:

- If a technical fault occurs the BCC can be reset to allow a recording of information about the carcass on the operative terminal. This includes subjective EUROP classification and a consecutive calculation of salable meat content, fat trim, muscularity index and value index.

- The transport of the carcasses through the centre is controlled by two independent control systems. If the normal BCC transport control fails, the secondary control system can be operative in 5 seconds and normal recording can take place.

- Recording and special transport of large split bull carcasses weighing more than 500 kg, each half carcass is then weighed separately (this facility is push-button controlled by the meat inspector).

- Recording, manual classification and special transport without positioning and automatic turning of carcasses which for example are contaminated (push-button control by meat inspector).

- Manual recording of different species e.g. sheep.

Construction etc.

The classification cabinet is covered with stainless steel sheets pop-riveted onto 50 x 50 stainless steel profiles. The cabinet includes a stop bar and a cross bar for positioning of the carcass, back-lighting and front lighting equipment, a CCD camera and automatic doors. The design of the stop bar is available in two versions according to whether complete (non-split) carcasses are hung on two hooks or on a gambrel suspended from a hook.

The maximum outside dimensions of the cabinet are: Height: 4.10 m x width: 2.45 m x length: 4.35 m.

The height of the overhead rail system above floor level is 3.18 m + nominal length of hooks. The maximum allowable variation in hook length is nominal length ± 50 mm.

Production engineering and final testing

The experience with the pre-prototype indicated that the mechanical sub-system had two main problems which should be solved in the prototype.

The pre-prototype required one operative for manual feeding of carcasses to the classification cabinet starting the BCC process by manual selection of either split or complete carcass operation. The second problem was concerned with condensation in the cabinet's illumination system.

Both problems have been solved in the prototype.

The pre-prototype software only included the programmes for video image analysis and reflection probe measurements. The prototype includes software for all the modes of operation mentioned above.

The final testing is taking place at the moment on the prototype installed in the OXEXPORT beef slaughterhouse in Kolding. The final test is a normal BCC operation 5 days per week for 3 months. The operative of the BCC is an employee of the slaughterhouse. The Institute monitors both technical failure and the results from the BCC operation.

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