ONLINECT FOR ASSESSMENT OF MEAT QUALITY

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I. INTRODUCTION

Since 2000 there a considerable amount of work has documented application of medical CT scanners for determination of the lean meat content of domestic animals [1-4]. However, this type of hardware is not suitable for online installation in a production environment, requiring high levels of sanitary design and radiation shielding. Two main opposed challenges exist in designing an online CT scanner: Radiation leakage level and image quality. Increasing the image quality also increase the radiation leakage so a lot of compromises have to be made to achieve the status as closed X-ray system with a leaked radiation dose rate of less than 5µSv/h, thus allowed in the Danish food production without installation of further radiation shielding means. Image quality in this work are assessed using a geometrical determination of subcutaneous fat thickness in pigs and a subjective evaluation of fat marbling in beef as examples. A sanitary designed prototype is constructed to illustrate the potential of OnlineCT scanning in the meat production.

II. MATERIALS AND METHODS

A sample of 20 pork middles is selected from a commercial abattoir. Each product is scanned in a medical CT scanner as reference, supported on a polystyrene tray and transported to the OnlineCT for scanning on the same support. The support minimizes the spatial difference between the two scanning sessions. From each of the two image stacks, two corresponding tomograms are selected and a geometrical mean of the fat thickness in the same anatomical position are determined by two separate operators. The result from the medical CT scanning is used as reference and compared to the corresponding assessment based on OnlineCT image stacks.
To illustrate a second potential of CT-based assessment of fat marbling a preliminary experiment is performed on striploin from beef. 7 samples of striploin from Danish beef are CT scanned in the medical CT scanner. The samples are cut into steaks to make a subjective assessment of the fat marbling using the USDA grading scale [x] and compared to a subjective evaluation, by the same operator, based on the CT generated images.

III. RESULTS AND DISCUSSION

In Figure 1 the graph shows the subcutaneous fat thickness in mm in the same anatomical position, measured on the images from the medical CT vs. the OnlineCT scanner prototype. The used reconstruction algorithm is adapted to the specific task: fat thickness close to the loin muscle. The average difference is 0.6mm with a standard deviation of 0.7mm. The result indicate that the prototype may be suited to measure some geometrical features relevant for pig meat quality assessment. The prototype satisfies Danish radiation leakage requirements for a closed x-ray scanner, thus it may be installed in a food production environment without auxiliary radiation protection means.

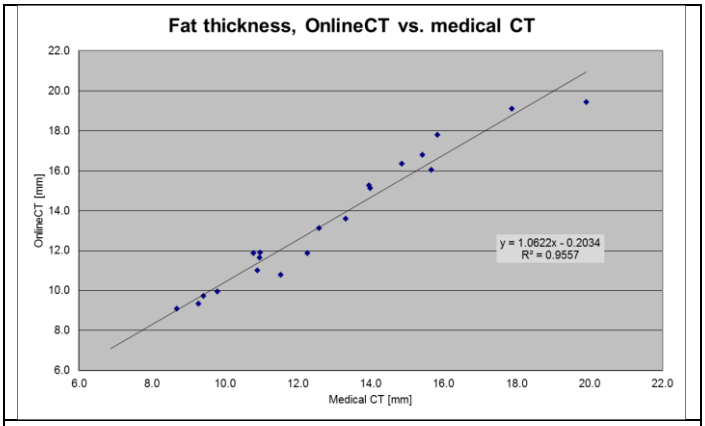
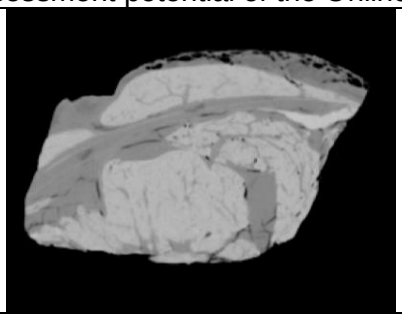


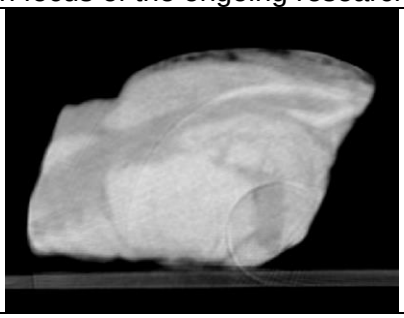
Figure 1. Manual measurement of subcutaneous fat thickness of pork middles based on images generated with medical CT (ref) and OnlineCT, respectively.

The more subjective assessment method based on CT images the results from the pilot experiment on 7 striploins indicate that using CT provides a nondestructive method for valuation of the level of fat marbling using the USDA grading scale. The pilot study

indicates the link between the (destructive) assessment of manually cut steaks and the images from the medical CT. The assessment potential of the OnlineCT images is the main focus of the ongoing research.

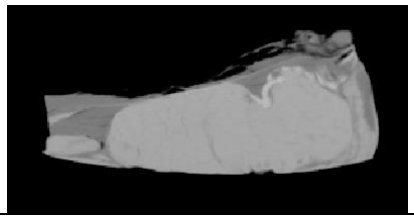


Highly marbled striploin measured with medical CT

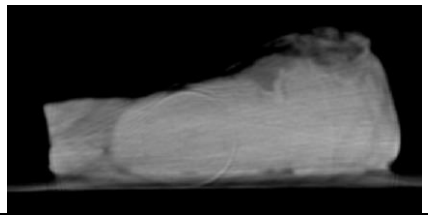


Highly marbled striploin measured with OnlineCT

RGB image of striploin



Medical CT image of striploin



OnlineCT image of striploin

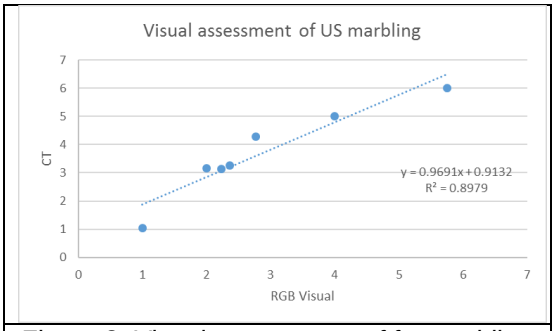


Figure 3. Visual assessment of fat marbling based on real cut steaks (RGB) and non-destructive medical CT images, Slight (=1) to Moderately Abundant (=6)

IV. CONCLUSION

The most important implications of this study are the validation of the OnlineCT prototype to determine the subcutaneous fat thickness with an offset of 0.6mm and a standard deviation of 0.7mm. One more major result is the demonstration of medical CT as a nondestructive method for subjective assessment of fat marbling of beef striploins.

ACKNOWLEDGEMENTS

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