ELECTROMAGNETIC SCANNING AS A MEANS TO DETERMINE LEAN CONTENT OF BEEF TRIMMINGS

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SUMMARY

Electromagnetic scanning, also known as ToBEC (total body electrical conductivity), was evaluated for its ability to determine lean content of beef trimmings. Beef trim contained within plastic tubs (approximately 22.7 kg) or boxes (31.8 kg) and varying in composition (approximately 30 to 90% lean) was scanned in an electromagnetic scanner. Weight, temperature, peak of the scan curve, and particle size of the trim was recorded. The lean was then ground and sampled for ether extraction of fat. Regression analysis was used to predict weight and percentage of fat-free lean using temperature, scan peak, and occasionally weight. For boxes weighing 31.8 kg and varying in composition and particle size, peak of the scan curve and meat temperature accounted for 94% of the variation in lean percentage, with a residual standard deviation (RSD) of 4.6%. When the lean was ground before scanning, the R-square was 98% and the RSD was 2.6%. The same variables, applied to samples that were 73% lean, gave an R-square of 84% and a RSD of .9%. When tub weight was not standardized, weight was added to the prediction equation. Thus, for percentage fat-free lean in 50%, 60% and 75% lean samples, the R-squares were 74%, 74%, and 78%, respectively, with RSD's of .9%, .8%, and .9%. These data indicate that electromagnetic scanning is a powerful tool to determine lean content of beef trimmings.

Introduction

Electromagnetic scanning is one technology to determine lean content of beef trimmings in a rapid, non-invasive manner. This technology, also known as total body electrical conductivity (ToBEC), is in commercial use for this purpose. A low-level electromagnetic field is created inside a large copper coil from a 2.5 MHz current. The amount of energy absorbed from this field by meat is related to lean content. Highly conductive materials (like metal) and lowly conductive materials (like fat) absorb much less energy than a material of intermediate conductance (like lean). The peak of the scan curve represents the greatest amount of energy absorbed by the sample and is influenced by meat temperature. The need exists to establish the strength of the relationship between electromagnetic scanning and lean content of beef trimmings.

Eustace and Thornton (1991) reported a correlation of 0.94 and a standard error of the estimate of 1.45% between electromagnetic scanning and chemical lean in 53 cartons of beef. In our laboratory (Gwartney et al., 1992, 1993), we have shown that ToBEC of beef hindquarters can account for 91% of the variation in lean weight (RSD=1.1 kg) and 80% in lean percentage (RSD=.63%). Forrest et al. (1991) have successfully applied the technology to pork.

Materials and Methods

Two studies were conducted. In study 1, 100 boxes (weighing 31.8 kg) of lean trim varying widely in particle size and composition were scanned in duplicate and temperature was recorded. Lean was then ground to 0.3 cm, and rescanned. Twenty boxes (31.8 kg) of homogenous composition (73.6%) were also scanned, ground and rescanned. Study 2 consisted of beef trimmings (0.95 cm) in plastic tubs. Ground beef was 49% lean (n=43), 64% lean (n=39), and 67% lean (n=20). After scanning, lean was ground to 0.3 cm in size. In all cases, lean was sampled from each unit (box or tub) for determination of fat and moisture content. Prediction equations for percentage lean (fat-free) were established which contained the peak of the scan curve, temperature, and (where appropriate) tub weight.

Results and Discussion

Table 1 indicates that the 100 boxes used in study 1 were quite variable in composition (56.6 ± 19.0% lean). As a result, the density of the boxes was variable. This variation resulted in an R-square value of .94 and a residual standard deviation of 4.6%. Grinding the lean to 2.5 cm improved the R-square to .98 and reduced the residual standard deviation to 2.6%. In contrast, the reduction of particle size from 2.5 cm to 0.3 cm in 73%-lean boxes caused a reduction in R-square (from .85 to .75) and an increase in the RSD (from .89 to 1.13%). These data suggest that when meat particles are too large, inconsistency in packing density can create inaccuracies in lean prediction. When particle size becomes too small (0.3 cm), the level accuracy also decreased. This was attributed to inconsistent packing of the lean into the boxes. Care must be taken when presenting samples to the scanner to avoid problems with lean prediction.

Eustace and Thornton (1991) indicated that meat particles which were excessive in size reduced the relationship of scanning to meat composition. In their study, however, particle was much larger (>2-3 kg) than in the present research (Thornton, personal communication).

When beef trim was removed from large meat containers (about 400 kg), ground to 0.48 cm, and scanned in plastic tubs, percentage lean was predicted within 1.7 to 2.4% RSD (Table 2). Similar results were found for each fat levels, where R-square values ranged from .68 to .74. There was a great deal of uniformity in composition within these three fat levels (standard deviations were 4.2% or less).

Conclusion

These data indicate that it is possible to use electromagnetic scanning to predict lean percentage of beef trimmings. However, care must be taken to ensure uniform particle size and packing within the boxes or tubs.

References

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