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APPLICATION IN THE MEAT INDUSTRY OF VELOCITY OF SOUND TO PREDICT BEEF CARCASS COMPOSITION

C. DENOYELLE*, A. FISHER**, Y. QUILICHINI *
*Institut de l'Elevage, Route d'Epinay, 14310 Villers Bocage, France
** Division of Food Animal Science, University of Bristol, Langford, Bristol BS187DY, United Kingdom.

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INTRODUCTION

At the moment, in France, beef carcasses are differentiated according to visual classification of conformation and fatness, the EUROP system. This system doesn't allow to estimate accurately the carcass composition. Developement of an objective measure of carcass composition is one of the major requirements by the slaughtering industry and producers, for breeding programmes for selecting animals with higher lean growth capacity and lower fattening capacity, for nutrition studies with the aim of developing feeding systems that limit fat depots, at slaughter for an objective classification of carcasses according to their composition. The University of Bristol (MILES, FISHER et al., 1990) developed a technique based on the measure of the velocity of sound (VOS) to predict the percentage of fat and the percentage of lean in the carcass from live or carcass measurements.
Previous experiments (RENAND et al., 1992) allowed to test this technique in "laboratory conditions" (carcass fat and lean percentages were estimated using a prediction equation from the dissection of the 6th rib and the weights of perirenal and precrural fat depots). VOS measurements appeared to be effective in predicting carcass composition (at slaughter, $R2=0.71$ - RSD = 0.87 for predicting carcass fat content and $R2=0.65$ - $RSD=1.05$ for carcass lean content).
The aim of this study was to compare VOS measurements with others techniques (EUROP classification - weight of subcutaneous fat trimmed - weight of kidney fat - carcass weight - visual assessment on the 6th rib) in "industrial conditions" to predict carcass composition. In this case, carcass fat, lean and bone were weighed according to 3 different commercial cuttings.

MATERIALS AND METHODS

The study was carried out on 526 animals in 3 different firms (3 groups of animals : 148 young bulls, 158 old cows and 220 of different types : old cows, young bulls and steers). The experiment was conducted over 3 days.

1st day : measurements were taken on live animals : Animal fatness and conformation were scored by an expert according to the EUROP system - The velocity of sound was measured at 4 anatomical sites (RENAND et al, 1992), 2 sites through the loin, just behind the shoulder and between the 13th rib and the 1st lumbar, and 2 sites through the thigh. Each animal was measured successively on the 4 sites and the measures were repeated once.

2nd day : measurements were taken on carcasses : Kidney fat and subcutaneous fat trimmed were weighed - Carcass fatness and conformation were scored by an expert according to the EUROP system - Carcass weight was recorded - The velocity of sound was measured at 6 anatomical sites (MILES et al, 1990), one in front of the 1st rib, one between the 10th and the 11th rib, one between the 7th and the 8th rib, one between the 7th and 8th thoracic vertebrae, one between the 10th and the 11th thoracic vertebrae, and the last between the 3rd and the 4th lumbar vertebrae.

3rd day : carcasses were cut : Visual assessments realised on the carcasses (only with 2 groups of animal : 148 and 158) at the 6th rib level (fat thickness on eye rib, intramuscular fat) and on thoracic and intercostal fat were scored by 3 experts from 1 = very lean to 7 = very fat - Carcass fat, lean and bone were weighed according to a commercial cutting, different for the 3 groups of animals
Data were analysed accross slaughter groups to compare the predictive value of information provided by each method using step-wise regression procedures from SAS (1988).
The variables to predict were : carcass and muscle contents (percentages of the carcass weight), the predictive variables were : live fatness and conformation scores, live measurements of velocity of sound (4 sites), kidney and subcutaneous fat trimmed weights, carcass fatness and conformation scores, carcass measurements of velocity of sound (6 sites), visual assessments at the 6th rib level (see previous).

RESULTS

Carcass fat prediction :

Percentages of the variance explained (R^2) and Residual Standard Deviations (RSD) obtained by each method for the 3 groups of animals are given in **table 1**.
Visual assessment at the 6th rib level appeared to be the best method to predict the carcass composition explaining 58 to 64 % of the variation of fat in the carcass (RSD = 0.99 and 1.22), while fatness score (live and carcass) and carcass weight explained less than 30 %.
Other methods such as carcass VOS and kidney and subcutaneous fat trimmed showed practically the same accuracy (e.g. on the 148 young bulls, respectively $R^2=0.56$ - $RSD=1.01$, $R^2=0.56$ - $RSD=1.01$). Moreover, with live animals, VOS showed a high accuracy to predict carcass fat content for the 3 groups of animals ($R^2= 0.43$ - $R^2 = 0.48$ - $R^2=0.43$). Finally, combination of VOS with other measurements such as fatness score improved the accuracy of predicting the carcass composition.

Lean carcass prediction :

Percentages of the variance explained and residual standard deviations obtained by each method for the 3 groups of animals are given in **table 2**.
Prediction of carcass lean content was less accurate than prediction of carcass fat content. All methods showed a low accuracy with R^2 less than 0.45. Carcass weight and conformation score showed no, or a poor relation with the carcass lean content ($R^2=0$, $R^2=0.02$). VOS live and VOS carcass combined with basic measurements showed the best accuracy (with live measurements, R^2 varies from 0.16 to 0.36, with carcass measurements, R^2 varies from 0.26 to 0.42).

DISCUSSION

Visual assessment on the 6th rib showed the best accuracy. However, this technique gives a delayed information, only at the carcass primary cut (one day after slaughter).

The technique based on kidney and subcutaneous fat trimmed weights had high accuracy, but the fat trimmeing process is different according to the operator, and the slaughterhouse.

Finally, these results confirm the potential efficacy of the measure of velocity of sound to predict carcass composition (MILES et al, 1990, PORTER et al, 1990, RENAND et al, 1992). This year, the results were less accurate. Measure of carcass composition based on commercial cutting could be an explanation. Indeed, this means is less precise than a prediction equation from the dissection of the 6th rib and the weights of perirenal and precrural fat depots to measure carcass composition.

For predicting lean carcass content, all methods showed a low accuracy. It is not conceivable to use one ot these technique to predict the lean carcass content.

CONCLUSION

Ultimately, these results could allow french abattoir operators who want an objective fat carcass content prediction to choose among these 3 techniques (VOS, kidney and subcutaneous fat trimmed weights or visual assessment on the 6th rib) one of which could resolve their particular problem (according to the moment of the measure and the expected precision).

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Table 1 : Comparison of the different methods to predict fat carcass content (%)

	220 animals (old cows, young bulls, steers) M = 7.3 % SD = 1.41		158 animals (old cows) M = 9.6 % SD = 1.38		148 animals (young bulls) M = 8.3 %SD = 1.52	
	R2	ISD	R2	ISD	R2	ISD
Live measurement						
Fatness score	0.02	1.31	0.20	1.78	0.08	1.46
VOS (4 sites)	0.43	1.02	0.48	1.46	0.43	1.24
VOS + fatness score	0.46	0.96	0.51	1.40	0.43	1.24
Carcass measurement						
Fatness score	0.08	1.22	0.28	1.69	0.18	1.38
Carcass weight	0	1.41	0.28	1.69	0	1.52
Kidney and subcutaneous fat trimmed weights	0.35	1.07	0.41	1.55	0.56	1.01
VOS (6 sites)	0.45	1.00	0.37	1.59	0.56	1.01
VOS + Fatness score	0.60	0.82	0.47	1.47	0.57	1 00
Visual assessments	nd	nd	0.64	1.22	0.58	0.99

Table 2 : Comparison of the different methods to predict lean carcass content (%)

	220 animals (old cows, young bulls, steers) M = 77.6 % SD = 2.16		158 animals (old cows) M = 68.7 % SD = 1.66		148 animals (young bulls) M = 73.2 % SD = 1.91	
	R2	ISD	R2	ISD	R2	ISD
Live measurement						
Conformation score	0.02	1.65	0.02	1.65	0.02	1.90
VOS (4 sites)	0.24	1.50	0.11	1.58	0.33	1.64
VOS + conformation score	0.32	1.40	0.16	1.51	0.36	1.51
Carcass measurement						
Conformation score	0.05	1.60	0.08	1.61	0.06	1.86
Carcass weight	0	2.16	0	1.66	0	1.91
VOS (6 sites)	0.31	1.41	0.15	1.52	0.34	1.57
VOS + conformation score	0.38	1.25	0.26	1.45	0.42	1.47
Visual assessments	nd	nd	0.18	1.51	0.35	1.54