AN ATTEMPT FOR PREDICTING LEAN MEAT IN BEEF CARCASSES BY SLAUGHTER RECORDS AND RIB SAMPLES BY X-RAY COMPUTER TOMOGRAPHY

[1]Holló, G., [1]Tran Anh Tuan, [2]Holló, I., [2]Repa, I., [1]Tőzsér, J. and [1]Szűcs, E.
[1]Gödöllő University of Agricultural Sciences (Gödöllő), [2]Pannon Agricultural University (Kaposvár) Hungary

BACKGROUND

The merit of cattle from the point of view of meat industry is determined by the quality of carcass. Carcass quality and carcass value are frequently used as synonym technical terms. Tissue composition of beef carcass can be determined only by complete dissection and tissue separation. It is a very hard and time consuming job and cannot be included into the technological process. In comparison with former procedures radical change has been made with *in vivo* estimation of carcass composition by the X-ray computer tomography (CT). In animal husbandry its application has been commenced in Norway from the early eighties. Introduction CT for breeding purposes and animal research was initiated by Horn (1991) in Hungary. The technique can be applied in all species (pig, sheep, rabbit, poultry etc.) having appropriate size (Horn et al., 1996). This mean an upper live weight limit of 150 kg. For this reason in case of cattle only young calves can be tested by CT. In spite of the limitations you have to search the way for the application of the procedure in question and further development. Thus, based on previous experiences the aim of this study was to analyze the opportunity for estimation of lean meat in beef carcasses using regression equation with records taken at slaughter and based on the CT analysis of 11-13 rib samples of young fattening bulls.

MATERIALS AND METHODS

Purebred Holstein-Friesian young fattening bulls (N = 31) were used in this study. At the end of fattening period the animal were slaughtered after 24 hrs lairage. The weight of head, four feet weight four feet and amount of internal fat as well as hot carcass weight were recorded at slaughter. Right half carcasses were dissected and muscle, bone and fat tissues were separated after chilling for 24 hrs. Simultaneously, samples from 11-13th rib were taken and volume as well as area of tissues were determined in 10 mm sections by Siemens Somaton Plus CT equipment in spiral mode at the Diagnostic Center of the Pannon Agricultural University, Kaposvár, Hungary. Records taken were analyzed by CTPC image software, where areas of different tissues (muscle, fat, bone and connective tissue) as well as water-like materials were determined on the bases of density values. Making use from the three dimensional analysis the volume of different tissues were determined. Intramuscular fat content in samples of M. longissimus dorsi (LD) were determined by chemical analysis. Figures analyzed in this study are presented in *Table 1.* These findings were used then for prediction of lean meat content of carcasses and included in the stepwise multiple regression analysis using SPSS program package.

RESULTS AND DISCUSSION

Average age and weight of animals at slaughter were 609 days and 527 kg, respectively. Figures of descriptive statistics are presented in *Table 1* and correlation coefficients are summarized in *Table 2.* Coefficients of correlation reveal relationship of lean meat content of carcasses to all parameters of volumetric percentages of tissues in rib sample determined by CT determined, but bone. Direction, i. e. of association seemed to differ, the lean meat percentage in carcass positively correlated with the volume of muscle in rib sample, and negative relationship were established to the ratio of water-like materials, fat tissue and connective tissue. Similarly, both internal fat recorded at slaughter and intramuscular fat in M. longissimus dorsi (LD) showed negative association with lean meat of carcasses. The results of stepwise multiple regression analysis are presented in *Table 4.* Multiple coefficient of regression and adjusted coefficient of determination for the regression equation developed were R = 0,78 and $R^{2\prime}$ = 0.58, respectively. The independent variables remained in the model were the volumetric percentage of muscle and fat tissue in rib sample by CT. Bivariate regression of carcass' lean meat percentage (y) on volumetric percentage of muscle as well as fat tissue analyzed by CT are demonstrated in Fig. 1 and Fig 2, respectively.

CONCLUSIONS

Conclusions drawn from the results of the present experiment are as follows:

1. Records taken at slaughter and analysis of rib samples using X-ray computer tomography as independent variables seems to be useful tools in predicting lean meat content of beef carcasses.
2. Perspectives for prediction of lean meat content of beef carcass are open by using X-ray measurement of muscle and fat in rib samples.
3. Further development is needed to improve the procedure in bovine species.

REFERENCES

Horn, P. 1991. A röntgen komputeres tomográfia alapjai és gyakorlati alkalmazás feltételei az állattenyésztésben. *Állattenyésztés és Takarmányozás*, 40. 1. 61-68. p.

Horn, P., Kövér, Gy., Pászthy, Gy., Berényi, E., Repa, I. and Kovách, G. 1996. Using X-ray Computer Tomography to Predict Carcass Leanness in Pigs. *Hungarian Agricultural Research*, 5. 3. 4-7. p.

Table 1 Means, standard deviations and range of variables

(N = 31)

Item		Mean	SD	Minimum	Maximum
Dependent variable:					
Lean percentage in beef carcasses	y	71.61	1.50	67.22	73.83
Independent variables:					
Internal fat (%)	x_1	2.05	0.74	3.39	0.57
Composition of rib sample (%)					
Water	x_2	3.53	0.48	2.76	4.65
Muscle tissue	x_3	67.86	2.58	60.62	71.61
Bone	x_4	17.13	1.80	95.86	162.64
Fat tissue	x_5	3.58	1.42	1.37	7.73
Connective tissue	x6	7.91	1.06	6.43	11.13
Intramuscular fat LD (%)	x_7	2.44	1.11	1.10	5.70

Table 2 Relation of independent variables (x_1-x_7) with the tissue composition (y) of beef carcasses

Variables		r	Significance
Internal fat (%)	x_1	- 0.48	**
Composition of rib sample (%):			
Water	x_2	- 0.62	***
Muscle tissue	x_3	0.69	***
Bone	x_4	0.08	
Fat tissue	x_5	- 0.71	***
Connective tissue	x_6	- 0.59	***
Intramuscular fat in LD (%)	x_7	- 0.42	*

* P<0,05
** P<0,01
*** P<0,001

Table 3 Estimation of lean meat content in beef carcasses using multiple regression equation

Multiple coefficient of correlation, coefficients of determination, standard error

Multiple coefficient of correlation	R	0.78
Coefficient of determination	R^2	0.61
Adjusted coefficient of determination	$R^{2'}$	0.58
Standard error	SE	0.97

Analysis of variance

Item	DF	SSQ	MQ	F	P
Regression	2	41.46	20.73	22.08	<0.001
Residual	28	26.28	0.94		

Regression equation
Dependent variable: lean meat percentage in carcass (y)

Item		Coefficients of regression	P
Independent variables			
Fat tissue	x_3	-0.49	<0.01
Muscle tissue	x_5	0.24	<0.01
Intercept	a	57.04	<0.001

Fig 1. Regression of carcass' lean meat on muscle in rib sample
Lean meat in carcass (%) = 44.29 + .40 x Muscle in rib sample (%)
r = .69

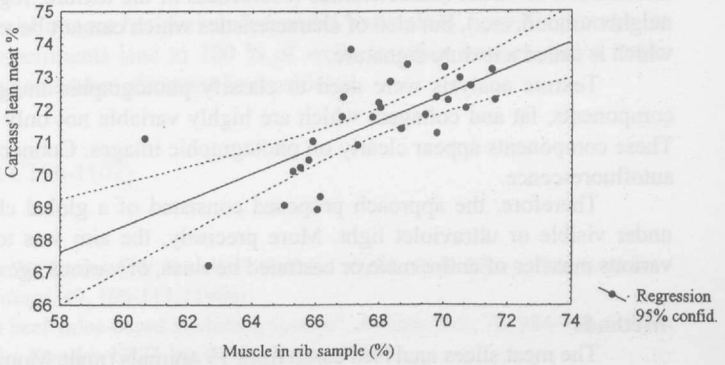

Fig. 2 Regression of carcass' lean meat on fat in rib sample
Lean meat in carcass (%) = 74.31 - .76 x Fat in rib sample (%)
r = -.71