ESTIMATION OF CARCASSES FOR LEAN MEAT CONTENT IN HOLSTEIN-FRIESIAN MALE CALVES BY HALF CARCASS WEIGHT, FATTY ACID COMPOSITION AND ADIPOCYTE DIAMETER

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Background

There are several studies evidencing that adipocyte diameter (together with other traits) in fat samples taken from different body sites is a suitable parameter for the estimation of body composition (*Lee et al.*, 1983; *Robelin and Agabriel*, 1986; *Renand et al.*, 1996). The amounts of polyunsaturated fatty acids can considerably be increased via forage fattening according to *Mandell et al.* (1998). The content of monounsaturated and polyunsaturated fatty acids, respectively, differs reportedly between the Limousine and the Jersey breeds (*Malau-Aduli et al.*, 1998). *Rule at al.* (1999) have evidenced between-breed differences (Limousine, Hereford, Pimento) in the fatty acid composition of longissimus muscle. *Huerta-Leidennz at al.* have found considerable differences in the MUFA values between the Hereford and Brachmann male calves at different stages of growth. In Hungary, *Holló at al.* (2001) have studied the effects of breed and live weight on the fatty acid composition of beef.

Objectives

The objectives of this study were dual: to evaluate that to what extent can be estimated the amount of lean meat by the size of adipocytes taken from different body sites, and to quantify the differences in the fatty acid composition of the various adipose tissues.

Materials and methods

On a total six male calves of the Holstein-Friesian breed, aged 187 days and weighing 240 kg an average, was examined. Calves were fattened on forage and concentrate feeds. After the slaughter, samples (0.5-1 g) were taken from the subcutaneous fat of the rump (ADS), the kidney fat (ADK) and the testicular fat (ADT), respectively. The adipocytes were exposed by means of collagenase enzyme (*Rodbell*, 1964) and adipocyte diameter was measured by the Cytosoft^R program. The levels of fatty acids were determined by means of gas-chromatography using a Chromopack CP 9000 equipment (saturated fatty acids: SAFA, monounsaturated fatty acids: MUFA, polyunsaturated fatty acids: PUFA). The results obtained for the unknown sample were given as a relative mass percentage of fatty acid methyl ester (*Csapó et al.*, 1995). Statistical evaluation of data was performed by means of the SPSS 10.0 software kit.

Results and discussion

Young bulls (aged 6 months) revealed no significant differences ($P>0.05$) in the mean diameters of adipocytes obtained from the subcutaneous fat of the ramp, the kidney fat and the testicular adipose tissue although the value was highest (57.50 um) for the latter parameter (Table 1). The proportion of fat cells is reportedly decreasing in the low diameter category (26-63 um) whereas it is increasing in the moderate (65-125 um) and high (>125 um) diameter categories with the increase of the live weight (Robelin, 1986). The results of the forward regression analysis are summarised in Table 2. With Model 1, of 7 independent variables only half carcass weight (x_3) was considered in the regression equation (r^2= 96.1 %, $P<0.001$, r_{sxy}=1.435). In case of Model 2, the diameter of adipocytes obtained from the kidney-fat (ADK, x_6) was already included in the estimation (R=99.2 %, $P<0.001$, r_{sxy}). The kidney fat samples contained saturated fatty acids (SAFA) in significantly higher percents ($P<0.05$; $P<0.01$) compared to the appropriate values for the subcutaneous and testicular fat (by 4.,6 % and 2 %, respectively), as Table 3 shows. In case of monounsaturated fatty acids (MUFA), the mean value for the subcutaneous fat exceeded the corresponding mean for the kidney fat by 2.6 % ($P<0.05$). The means for the polyunsaturated fatty acids (PUFA) were comparable. Interestingly, the correlation coefficients obtained among the three sampling sites in variable MUFA were fairly heterogeneous (r=0.15-0.88). The corresponding values for variable SAFA and PUFA were more homogenous (r=0.59-0.92; r=0.90-0.94).

Conclusions

1. Mean adipocyte diameter of kidney fat and half carcass weight either can be correctly used for the estimation for lean meat content even in young age (6 months).
2. The higher proportion of saturated fatty acids found in the kidney fat suggests that the primary accumulation site of fat is the abdominal cavity in young age. The comparable MUFA values found in the three sampling sites is interesting, however.

Table 1. Means and standard deviation for age, slaughter weight, carcass traits and adipocyte diameter

Variables	Mean±SD
Age, day, x_1	187.6±31.28
Slaughter weight, kg (SW)x_2	240.2±38.26
Weight of hot carcass halves, kg (WHC) x_3	114.9±18.35
Weight of lean meat content, kg (WLM) y	36.1±6.53
Weight of fat (trimmed + kidney), kg (WF) x_4	3.79±0.81
Adipocyte diameter, μ	
Subcutaneous fat (rump)(ADS) x_5	48.85±11.75
Kidney fat (ADK) x_6	47.45±13.18
Testicular fat (ADT) x_7	57.50±10.70

Table 2. Estimation of lean meat content by half carcass weights and diameter of adipocytes from kidney fat

Models	Dependent variable (y)	Independent variables (x_1 -x_7)	Coefficient of determination (R^2)	Residual standard error (r_{sxy})
1	Weight of lean meat content (kg) (WLM)	Weight of hot carcass halves, kg (WHC) x_3	0.961***	1.435
2		Weight of hot carcass halves, kg (WHC) x_3 Adipocyte diameters (μ) from kidney fat, x_6 (ADK)	0.992***	0.747

*=P<0.05; **=P<0.01; ***P<0.001

Table 3. Fatty acid composition of different fat samples

Variables	Subcutaneous fat	Kidney fat	Testicular fat
Saturated fatty acides,%	45.32±3.21[b]	49.97±3.08[ab]	47.99±4.01[a]
Monounsaturated fatty acides,%	43.03±2.45[a]	40.44±1.62[a]	40.79±2.73
Polyunsaturated fatty acides,%	5.62±1.69	5.79±1.40	5.45±1.11

The differences in the values of the appropriate variables were significant at a=P<0.05, b=P<0.01 level, respectively.

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