Effect of genotype and age on quality of beef

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Introduciton

In cattle breeding strategies beef quality traits are to be considered. Concerning basic genotypes limited information has been available on chemical composition and palatability as affected by genotype and chronological age in selected muscles. For this reason studies were carried out with Hungarian Red Spotted /n=9o/ and Holstein Friesian /n=3o/ bull calves slaughtered at 200, 350 and young bulls slaughtered at 500 days of age. In addition chemical composition was investigated with Hereford /n=1o/ young bulls slaughtered at 500 days of age.

Material and methods

Animals were fed with maize-silage based diets throughout the whole experimental period, only small amounts of concentrate and wheat straw as roughage were dispensed. Muscles analysed were as follows: M. longissimus dorsi /LD/, M. semitendinosus/ST/, M. psoas major /PS/. Analytical methods used for moisture, fat, protein, total connective tissue, soluble connective tissue, total pigment, drip loss, Warner-Bratzler shear force value and GÖFO surface reflectance are listed in the publication of the Hungarian Meat Research Institute published in 1973 and in the COMECON standard /1979/. As statistical method two and/or three way analysis of variance was applied.

Results and Discussion

1/ Chemical composition. The mean values of percentage of intramuscular fat are presented in Table 1 and Fig 1a. In PS fat content steadily increased during growth in both genotypes, however in case of Holstein Friesian are in general higher. Among the muscles significant differences /$P < 0.001$/ were obtained for fat content, however, until 350 days of age no substantial increase could be observed in ST and LD. In the case of Hungarian Red Spotted the rate of increase in LD and ST seems to be lower than that is in the Holstein Friesian muscles between 350 and 500 days of age. The significant /$P < 0.001$/ interactions between genotypes and ages are shown in Fig 1a. Further interaction /$P < 0.001$/ between muscles and ages may be associated with the different rate of increase between PS and the other two muscles.

When muscles of Hungarian Red Spotted, Holstein Friesian and Hereford young bulls slaughtered at 500 days of age were compared /Tab. 2, Fig. 1b/, the highest fat content were found in Holstein Friesian. The lowest percentage of fat content can be observed in Hungarian Red Spotted breed /$P < 0.001$/, while in Herefords it represents intermediate position, except for PS when no significant difference could be recorded between the Holstein Friesian and Hereford breeds.

Genotypes, ages and muscles showed significant /$P < 0.001$/ effects, however only slight differences were found among means of protein content. This can be explained by the strong correlation between percentage of fat and moisture. /Körmendy et al. 1981/ Consequently, percentage of fat and moisture adequately reflect the chemical composition of tissue.

For total connective tissue statistical differences /$P < 0.001$/ has been established among genotypes, muscles and chronological ages. Differences among selected muscles seem to be obvious, the order is as follows: PS, LD and ST. It can be seen in Fig. 2a that the total connective tissue in Holstein Friesian increased to a greater extent

with the progress of chronological age as compared to Hungarian Red Spotted. Higher values /P < 0.001/ with advanced age might be due to the higher proportion of perimysium, since the relative amount of endomysium decreased with higher fibre diameters. Our findings are in agreement with the results of Boccard /1978/ who emphasizes that this phenomenon can be shown in advanced age especially in dairy cattle. Different increase in total connective tissue among breeds is associated with interactions of age and genotype.

At 300 days of age highest means for total connective tissue /P < 0.001/ were recorded in Holstein Friesian /Tab. 2, Fig. 2b/, while lowest level of total connective tissue was were found in Hereford. These findings are in accordance with our results presented in Fig. 2a - development of intramuscular connective tissue is associated with genotype, i.e. dairy and/or beef character. Specific anatomical parts of intramuscular connective tissue i.e. endomysium and perymysium consist of genetically different collagens /Bailey, 1976/ which differ in the proportion of thermostable cross-links influencing the soluble part of connective tissue. According to age and genotype distribution of endomysium and perimysium varies, the thermostable cross-links generally increase during growth. In intramuscular soluble connective tissue clear differences /P < 0.001/ were established among genotypes, muscles and age groups examined /Tab. 1 and 2/. Total pigment levels /mg/g wet tissue weight/ are presented in Tab. 1 and 2, and in Fig. 3a, b. Among breeds and ages, as well as muscles significant differences /P < 0.001/ were recorded. Interaction /P < 0.001/ between breeds and ages may be due to the elevated values in Holstein Friesian at 200 days of age and the higher rate of increase in Hungarian Red Spotted during growth. The higher amount of total pigment in Holstein Friesian at age of 200 days is probably due to the higher live weight, this finding is in accordance with the results of van der Wal et al. /1978/. At 500 days of age only slight differences were present in total pigment content among genotypes /Tab. 2/.

2/ Beef quality traits. Drip loss, cooking loss, W-B, shear force value and surface reflectance /GOFO/ were determined, the result are shown in Tab. 1. As it is known, traits of palatability are related to the ultimate pH, therefore samples above pH 5.8 have been ommitted from the evaluation in order to ensure only normal quality beef in our analysis for comparison of breeds and ages. In the case of Holstein Friesian means of drip loss were higher /P < 0.01/ in comparison to Hungarian Red Spotted. At higher ages drip loss decreased /P< 0.001/, but no significant differences were found between LD and FS. Similarly, the means for cooking loss were higher in Holstein Friesian versus Hungarian Red Spotted /P < 0.001/. No significant differences were obtained according to ages, however, in LD higher cooking loss was found as compared to FS.

Regarding W-B, shear force value no significant change was observed between genotypes or ages in this study. In general, shear force values seemed to increase with advanced age, however, in this experiment animals were slaughtered at relatively young ages. Obvious difference between LD and FS was also recorded. Surface reflectance measured by GOFO was influenced by age and muscles, however genotypes had no effect. In a former study it was a stablished by Vada et al., /1981/ that there is a strong multiple correlation among surface reflectance, pH and total pigment content /R=0.76/. Since the effect of pH was eliminated by omission of samples with higher pH_{ult} variations in surface reflectance are associated with pigment levels /Tab. 1,2, Fig. 3a,b/.

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Table 1

Effect of genotype, muscle and age on the composition of beef and on quality traits

Item	Sources of variance: Genotypes		Muscles[1]			Ages /days/		
	Hungarian Red Spotted	Holstein Friesian	LD	ST	PS	200	350	500
Chemical components								
Moisture /per cent/	76.2	75.4	75.8	76.6	75.1	76.5	75.6	75.3
Fat /per cent/	1.71	2.68	1.99	1.49	3.1o	1.45	2.o4	3.1o
Protein /per cent/	21.8	22.3	22.4	22.o	21.9	21.8	22.5	22.o
Total connective tissue	o.89	1.o3	o.88	1.29	o.69	o.71	o.93	1.23
Soluble connective tissue	17.3	12.8	15.9	12.1	17.1	19.6	13.8	11.7
Total pigment /mg/g/	2.95	3.27	2.89	2.32	4.11	2.54	2.95	3.83
Quality traits depending on pH[2]								
Drip loss /per cent/	2.95	4.31	3.92	-	3.o4	6.11	3.o2	1.77
Cooking loss /per cent/	26.o	31.2	3o.3	-	26.9	3o.o	27.4	28.4
W-B. shear force value /N/	37.2	34.8	42.6	-	29.4	33.5	34.6	4o.o
GÜFO /per cent/	71.3	73.2	7o.6	-	73.9	71.8	69.7	75.3

1/ LD=M.longissimus dorsi, ST=M.semitendinosus, PS=M.psoas major

2/ Samples with ultimate pH values above 5.8 excluded.

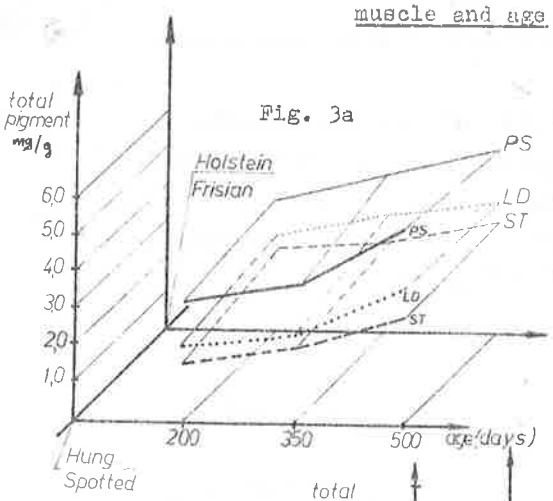
Table 2

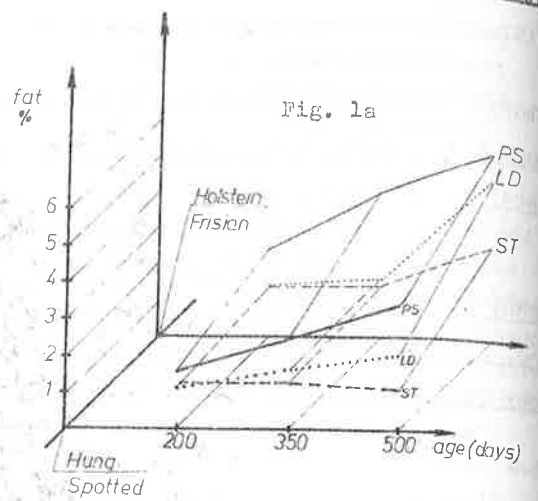
Effect of genotype and muscle on the chemical composition of beef: young bulls slaughtered at 500 days of age

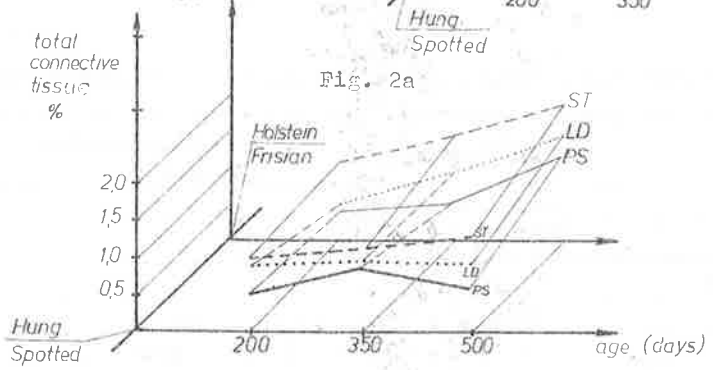
	Source of variance: Genotypes			Muscles[1]		
	Hungarian Red Spotted	Holstein Friesian	Hereford	LD	ST	PS
Chemical components						
Moisture /per cent/	76.1	74.5	73.5	74.6	75.9	73.6
Fat /per cent/	2.15	4.o4	3.81	3.38	1.98	4.64
Protein /per cent/	21.8	22.2	22.8	22.5	22.2	22.1
Total connective tissue /per cent/	o.96	1.51	o.73	1.o2	1.41	o.77
Soluble connective tissue /per cent/	13.9	9.4	1o.8	12.2	9.3	12.7
Total pigment /mg/g/	3.9o	3.76	3.55	3.53	2.75	4.94

1 = LD = M. longissimus dorsi, ST = M. semitendinosus, PS = M. psoas major.

Intramuscular fat, connective tissue and pigment in muscles depending on genotype, muscle and age







Intramuscular fat, connective tissue and pigment in muscles depending on genotype /young bulls slaughtered at 500 days of age/