ANTAGONISM IN DIFFERENT CARCASS AND MEAT QUALITY TRAITS OF CATTLE

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SUMMARY

The antagonistic relations between and within the traits of growth, muscling, carcass and meat quality of -the dual-purpose cattle "Deutsches Fleckvieh" were investigated by calculating the correlation coefficients. 120 young bulls from progeny testing for meat performance were examined. Beyond the antagonistic relations between musculature and fat only few significant antagonistic relations were found. The improvement of the fattening yield leads to an increase of the fatty tissue; this relation is antagonistic by sense. With increasing daily gain also the drip loss increases. If the muscling increases the pH drops quicker and the drip loss rises. These relations however are not statistically significant, Distinct antagonistic relations exist between the lean meat proportion in the carcass and the fat, but also to meat quality characteristics as marbling, colour, tenderness and flavour. The pH value indicates antagonistic relations to tenderness, juiciness and flavour.

INTRODUCTION

Growth and muscling are the most important factors of selection in beef production; other characteristics are usually not directly considered. The relations between the preferred characteristics of selection and other traits of the slaughter value are not always positively correlated, partly even antagonistic. Correlation coefficients hIve been calculated in order to see if there are negative correlations and also to find those positive correlations which have a negative effect on the carcass and meat quality. Correlated were:

- traits of growth with traits of the carcass and meat quality
- traits of muscling with traits of the carcass and meat quality
- gross tissue composition of the carcass (lean, fat, bone) with traits of the meat quality
- different traits of meat quality.

MATERIAL AND METHODS

One hundred and twenty young bulls (10 sires with 12 offsprings each) of the dual purpose breed "Deutsches Fleckvieh" (Simmental) out of the progeny test were used. Feeding was equal for all animals (maize, silage ad lib., 2 kg hay and average 2 kg concentrate mainly as protein supplement). Slaughtering took place at an age of 500 days. Table 1 shows the "basis" parameters of the test material. All traits diverge distinctly in spite of the same age of slaughter and the same feeding. The animals were slaughtered under standardized conditions. Since the stable was located near the test slaughterhouse, no

Table 1: Means, standard deviations and range of "basis" parameters of the experiment (young bulls - German Fleckvieh - slaughter age 500 days) n = 118

Traits		$\bar{x}$	s	range
Live weight	kg	613,4	45,5	482 - 737
Hot carcase weight	kg	350,5	27,6	252 - 417
Dressing	%	58,7	1,3	54,1 - 61,7
Gain	g/d	1211,3	98,6	932 - 1468
Net gain	g/d	703,5	54,9	506 - 843
Kidney/pelvic fat	%	3,2	0,7	1,7 - 6,4

Table 2: Antagonism between fattening yield and carcase and meat quality traits (correlation coefficients)

Daily gain					
Carcase quality			Meat quality		
Bone (carcase)	%	-0,59**	Drip loss	%	+0,26*
Pistola	%	-0,11	Shear force	kg	-0,18
Lean/fat	:1	-0,05	Heating loss	%	-0,23
Fat (carcase)	%	+0,36**			
Fat class		+0,31*			
Fat (best ribs)	%	+0,23			
Live weight					
Bone (carcase)	%	-0,64***	Drip loss	%	+0,24
Pistola	%	-0,08	Shear force	kg	-0,20
Lean/fat	:1	-0,11	Heating loss	%	-0,23
Fat (carcase)	%	+0,45***			
Fat class		+0,37**			
Fat (best ribs)	%	+0,26*			

Significance: *** $p \leq 0{,}001$, ** $p \leq 0{,}01$, * $p \leq 0{,}1$

Table 3: Antagonism between muscling and carcase and meat quality traits (correlation coefficients)

Fleshiness (EUROP)					
Carcase quality			Meat quality		
Bone (carcase)	%	-0,33**	pH 6 hrs p.m.		-0,11
Fat (carcase)	%	+0,14	pH 22 hrs p.m.		-0,21
Fat class		+0,16	Drip loss	%	+0,24
Fat (best ribs)	%	+0,13	Shear force	kg	-0,30*
M.long.dorsi area					
Fat (carcase)	%	-0,18	pH 6 hrs p.m.		-0,15
Fat class		-0,13	pH 22 hrs p.m.		-0,17
Fat (best ribs)	%	-0,26*			

Significance: ** $p \leq 0{,}01$, * $p \leq 0{,}1$

Table 4: Antagonism between carcase quality traits and meat quality traits (correlation coefficients)

Carcase composition					
	Lean in carcase			Fat in carcase	
Fat (carcase)	%	-0,87***	Lean (carcase)	%	-0,87***
Fat (best ribs)	%	-0,53**	pH 3 hrs p.m.		-0,22
Fat (M.long.d.)	%	-0,24*	pH 6 hrs p.m.		-0,27*
Marbling score		-0,37**	Shear force	kg	-0,23*
Lightness (Hunter L)		-0,25*			
Panel score					
Tenderness		-0,11			
Juiciness		-0,14			
Flavor		-0,21			
Shear force	kg	+0,14			

Significance: *** $p \leq 0,001$, ** $p \leq 0,01$, * $p \leq 0,1$

Table 5: Antagonism within meat quality traits (correlation coefficients)

Meat quality					
	pH 6 h p.m.			pH 48 h p.m.	
Panel score					
Tenderness		-0,24*	Lightness (L*)		-0,24*
Juiciness		-0,18	Panel score		
Flavor		-0,23	Tenderness		-0,20
Shear force	kg	+0,20	Flavor		-0,29*
			Drip loss	%	-0,34**
			Heating loss	%	-0,22
			Shear force	kg	+0,21

Significance: ** $p \leq 0,01$, * $p \leq 0,1$

lorry transport was necessary. Many different parameters were recorded during the investigation in order to determine potential antagonistic relations. The growth was determined by recording of the daily gain, net gain, final fattening weight and carcass weight.

The conformation was judged by subjective evaluation of the profiles of round, back and shoulder, the determination of the fleshiness (European Classification System, EUROP), various measurements at the round (round circumference, spiral round measure, round width and round depth) as well as the determination of the loin-eye-area between 8 th and 9 th thoracic vertebra.

The proportion of primal cuts (pistola) was used for the determination of the carcass quality- Besides that the proportion of the lean, fat and bone of the carcass was estimated. In the prediction equation the tissue proportions of the thin flank, the half carcass weight, the kidney and pelvic fat and the weight of the four legs were included.

The meat quality evaluation was carried out mainly according to the proposed methods of the ECE working group in the beef research program (Boccard et al. 1981). It comprised besides the sensory examination the determination of the pH-drop after slaughter (pH 45 min, 3, 6, 22 and 48 h p.m.), the determination of the concentration of the metabolites of the postmortem glycolysis (glycogen, lactate, ATP, creatine phosphate) (Fischer and Augustini 1977), the colour (Hornsey 1956) and physical colour measurements (Hunter L*, a*, b*), the fat content of the *M.longissimus dorsi* and of the entire best ribs (ISO 1973), the marbling, the shear force (Warner-Bratzler) and the drip loss (weight loss between 48 hours after slaughter and the 9 th day) (Kim et al. 1985). All examinations were carried out at the *M.longissimus dorsi* and the best ribs (8 th / 9 th - 11 th / 12 th thoracic vertebra).

Sensoric evaluation took place after 13 days of aging at +2°C with low vacuum. A 2 cm thick slice from the best ribs (9 th / 10 th thoracic vertebra) was heated in a plategrill until 70°C (approximately 7 min). Only the *M.longissimus dorsi* was used for tasting. The test was carried out by a 6 member panel which scored the sample for tenderness, juiciness and flavour according a 6 point scale, where "6" is very desired and "1" not desired. The remaining part of the *M.longissimus dorsi* was used for shear force measurements. 6 cylindrical samples (∅ 1.25 cm) were cut parallel to the muscle fiber and the shear force was calculated on the basis of these measurements. Heating loss was recorded by weighing the samples before and after grilling.

RESULTS AND DISCUSSION

Various numbers of traits have been investigated which can be summarized under growth, muscling, carcass and meat quality.

Antagonistic relations between traits of the growth and traits of carcass and meat quality

There are predominately correlations with positive signs. Among the traits of the carcass quality only the proportion of primal cuts (pistola) and the meat/fat ratio in the carcass are negatively correlated to the criteria of the fattening yield (table 2). Antagonistic, but economical desired, is the negative correlation between growth and bone proportion of the carcass. Although the fat criteria are positively correlated with the fattening yield they have to be considered as antagonistic in case of the carcass composition, since increasing daily gain leads to an increase of the fatty tissue proportion in the carcass. The drip loss was in all samples very low (2.27 ± 0.6 %; range: 0.98 - 4.21), but positively correlated with the criteria of the fattening yield. The positive correlation in this case has to be considered negatively because higher daily gain show higher drip losses. In reverse are the negative correlations between fattening yield and shear force to be considered as positive since heavier carcasses show at least in tendency a better tenderness as far as the animals are slaughtered at the same age, which was the case in the present test. The negative correlations between fattening yield and grill loss have to be valued as positive since with increasing weight the grill loss is decreasing. The correlation coefficients of the pH-values -measured at different times after slaughter - and of the metabolites of the postmortem glycolysis to the fattening yield were not different from zero.

Antagonistic relations between the muscling and traits of the carcass and meat quality

The correlation coefficients between traits of muscling and carcass and meat quality traits are generally very low (table 3). It exists the tendency that the proportion of fatty tissue increases in the carcass at the improvement of muscling, if the muscling is subjectively scored. But if one takes the loin-eye-area as criterion for the muscling it shows antagonistic relations with the degree of fatness, i.e. the fatness is getting lower at increasing loin-eye-area. This can be valued positively in the view of the carcass quality. The muscling also shows low but negative correlations to the pH-value. There is a tendency to a faster pH-drop and a higher drip loss with increasing muscling.

Antagonistic relations between traits of the carcass composition and meat quality traits

The most important components of the carcass are the proportion of lean meat and the proportion of fatty tissue. There is a distinct antagonism between both proportions (table 4). Above that correlates the lean meat proportion negatively with some traits of the meat quality. At increasing proportion of lean is the meat getting darker and the sensory characteristics are scored inferior. Also the positive correlation between musculature and shear force has to be valued negatively by sense. The fatty tissue proportion correlates negatively with the shear force, a hint that with an increasing fat proportion the tenderness is getting better.

Antagonistic relations between different traits of meat quality

Between the pH-values 6 and 48 h p.m. and some quality traits a tendency to antagonistic relation is found. As well the 6 h p.m. pH-values as the final pH-values correlate negatively with the sensory traits of tenderness and flavour. The positive correlation with the shear force confirms the sensory judging of the tenderness (table 5). The negative correlations of the final pH-value to the colour and also to the drip and grill loss can not be attributed to DFD meat. The average final pH-value was 5.45 ± 0.05 (range: 5.34 - 5.59).

CONCLUSIONS

The results presented demonstrate some antagonistic relations. Clearly antagonistic are the relations between some carcass composition traits e.g. lean meat and fat proportion as well as between lean meat proportion in the carcass and some meat quality traits as marbling, tenderness and flavour. Between the fattening traits and muscling on the one hand and fat, drip loss and pH on the other hand, antagonistic relations were also found, but they are only in few cases significant. The samples were taken from a relatively limited material, which is therefore not representative for the breed "Fleckvieh", but the existence of antagonistic relations is as least a signal for an unilateral selection. It would be necessary to carry out a comprehensive analysis in order to counteract in time to prevent such developments as we know from pig breeding.

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