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DEVELOPMENTS IN CATTLE CARCASS GRADING

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SUMMARY

Proceeding from the target of carcass marketing, the state of the art in the GDR and latest findings, the authors describe possibilities of assessing carcass quality on the basis of the carcass components lean meat, fat and bones and the relationships between these tissue groups. In future, greater attention must be paid to proper grading of carcasses according to tissue groups, ensurance of an optimum fat content, more accurate assessment of the bone percentage and to a greater complexity of classification.

INTRODUCTION

For marketing purposes, beef carcasses must be graded. This should be done on the basis of an objective scale of merit reflecting both tissue components and utility value of the carcass. Main criteria of grading are carcass composition, cutability and meatiness of the major cuts round and rump.

The conditions at the slaughterline require a grading system based on readily assessable auxiliary traits which must be closely correlated with the slaughter value. In the GDR, all carcasses of bulls, heifers and cows are separately graded since 1976 according to carcass weight and kidney fat as traits which can be objectively recorded. Light carcasses have a higher bone percentage and are thus of minor carcass grades. The highest grade is for heavier carcasses with the lowest percentage kidney fat. However, the objective assessment of heavier beef carcasses with high bone percentage is somewhat problematic like the ensurance of an optimum fat content, as well. The experience gained hitherto in carcass grading and marketing and the results of research work done so far in this field contribute to further objectify the assessment of carcass quality using exclusively objective methods of carcass appraisal.

Measuring instruments as have already been employed in pigs have so far not been used for beef carcass assessments, but such approaches are necessary and must be made on a complex scale including the use of computers, as well.

MATERIALS AND METHODS

Studies were made into 617 fattening bull carcasses of the GDR Black-Pied dairy breed (SMR). These carcasses were divided into cuts and tissue groups and chemically analyzed. For classification of the carcasses, hot carcass weight, kidney fat content, weight of head and four feet as well as carcass length were determined. Marketing records on the carcasses of 23,177 fattening bulls, 10,870 cows and 3,151 heifers provided confirmatory evidence of the relationships between weight and fatness and existing variations within these traits.

RESULTS AND DISCUSSION

Carcass weight

Carcass tissue composition is mainly influenced by age and weight of the animals at slaughter. The great variation in carcass weight typical for beef production suggests that it would be favourable to use this trait not only for quantitative assessment and pricing of carcasses but also for the appraisal of carcass quality. Table 1 outlines the carcass weight of fattening bulls indicating that with increasing weight the percentage lean meat remains almost constant.

Table 1. Carcass composition in SMR fattening bulls

Hot carcass weight (kg)	Lean (%)	Bones (%)	Fat (%)	Kidney fat (%)	Edible fat (%)
≤ 139	71,6	23,3	5,0	1,2	4,7
140 -	71,9	20,6	7,5	1,7	6,0
200 -	71,0	19,2	9,7	2,5	9,5
260 -	71,8	18,2	10,0	3,4	12,7
≥ 320	73,5	16,8	9,9	4,7	15,8

While the bone percentage declines by one third from 23 to 17 %, fat percentages double or even triple, the edible fat content, for instance, rises from 5 to 15 %.

These weight-specific changes can be clearly shown in larger groups of animals. Another considerable component of the variation in carcass composition was not found to depend on weight but on other factors, especially fattening intensity. Weight, hence, allows a general prediction of carcass composition but, to ensure a higher accuracy of qualitative carcass assessment, traits of the individual tissue components should be analyzed in addition.

Meat percentage

According to the commercial production target, carcasses are expected to have a high percentage lean meat. The meat cuts being mainly retailed or processed consist of muscle or lean meat with different contents of intramuscular fat. The percentage meat cuts has only a low predictive value for the carcass lean content, since these cuts still contain the bones. The predictive value of other traits which are easy to measure and directly correlated with the lean percentage has so far also not been satisfactory.

A high percentage of steak and roll cuts is especially demanded from beef carcasses. It is directly dependent on the edible fat content. Optimum values for weight and edible fat percentage which are to be reached with regard to changes in the roast meat assortment reflecting the changes in consumer wishes. The optimum range of 7 to 12 % edible fat is hence equivalent to 2 to 3 % kidney fat. Higher and lower percentages are disadvantageous.

Fat percentage

The percentage of the various fat components is closely correlated with carcass and meat qualities. Kidney fat seems to be an especially promising trait for objective carcass grading, since trait variation is high and measurement relatively simple.

Table 2 outlines the correlations between kidney fat percentage and hot carcass weight, on the one hand, and other fat parameters, on the other.

Table 2. Kidney fat (%) and hot carcass weight as correlated with other fat parameters in SMR fattening bulls

	Kidney fat (%)	Hot carcass weight
Hot carcass weight	0,78	
Edible fat (%)	0,88	0,83
Kidney/ intestine fat (%)	0,87	0,81
Intramuscular fat in M. long. dorsi (%)	0,28	0,34

Correlations of 0,87 and 0,86 are, for instance, reported between kidney fat and kidney/intestine fat and total edible fat, respectively. A comparatively loose correlation of r = 0,28 was found with intramuscular fat content which provides for the desired marbling. This fact leads to the conclusion that increases in weight and total fatness do not mean necessarily that the intramuscular fat content rises. The correlation of 0,78 between kidney fat percentage and hot carcass weight proves that the heavier the carcass grows the fatter it will be. Further evidence of this relationship is provided by comprehensive analyses of carcass grading results (Fig. 1 - Fattening bulls, Fig. 2 - Cows, Fig. 3 - Heifers).

In all carcass grades, kidney fat percentage rises with increasing hot carcass weight at a correlation of r > 0,8. Hence follows a marked increase in fatness along with rising weight. The standard deviation in the Figure marks the considerable weight-independent component of the variation. Cows and heifers show an almost identical weight-dependent fat deposition which was found to be slightly degressive as compared with bulls where it is slightly progressive with a regression coefficient that is but half as high. The intended optimum fat percentages are reached earlier in cows and heifers, but may be exceeded already at lower hot carcass weights. Bulls do not grow fat so rapidly, but this causes other problems associated especially with the bone content being too high.

Fig. 1. Linear and quadratic regressions of kidney fat (%) on hot carcass weight (kg) in fattening bulls

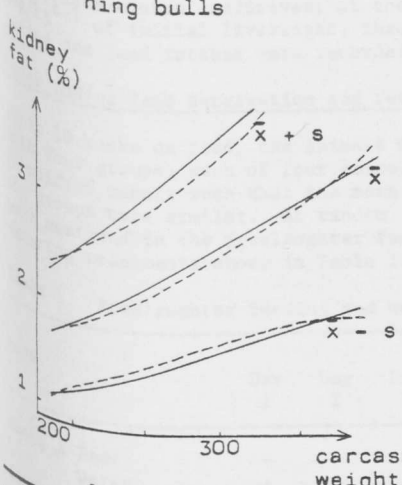


Fig. 2. Linear and quadratic regressions of kidney fat (%) on hot carcass weight (kg) in cows

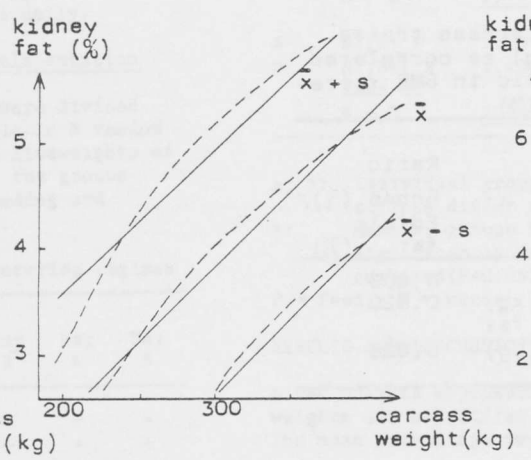
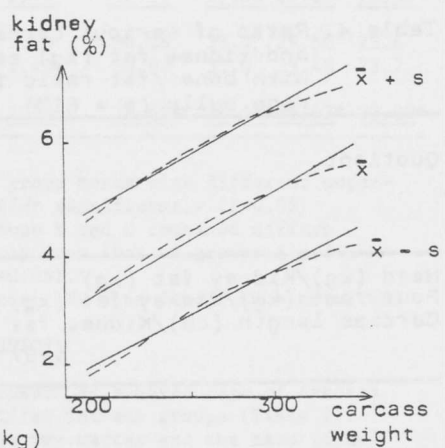


Fig.3. Linear and quadratic regressions of kidney fat (%) on hot carcass weight (kg) in heifers



——— linear set-up

- - - - - - quadratic set-up

y= 0,229 + 0,008x
y= 0,749 + 0,004x+0,000007x^2
n= 23177 r = 0,88
kidney fat(%)$\bar{x}$= 2,1 ± 1,0
carcass weight(kg)$\bar{x}$ = 240

y=-0,588 + 0,015x
y=-3,801+0,037x-0,00004x^2
n= 10870 r = 0,87
kidney fat(%)$\bar{x}$= 3,1 ± 1,2
carcass weight(kg)$\bar{x}$ = 261

y= 0,234 + 0,016x
y=-2,275 + 0,037x-0,00004x^2
n = 3151 r = 0,80; 0,81
kidney fat(%)$\bar{x}$= 3,5 ± 1,5
carcass weight(kg)$\bar{x}$ = 209

Bone percentage

In future, efforts must be made to assess the bone percentage more precisely, since bones do not belong to the edible parts(as opposed to edible fat, although this is more or less disfavoured). Studies involving SMR fattening bulls revealed a correlation of $r > 0,6$ between the percentages of head and four feet, on the one hand, and bone percentage, on the other. The relative carcass length is even closer correlated with the bone percentage at $r > 0,7$. The correlations between fat percentages and bone content are similarly close but in the negative range (Table 3).

Table 3. Correlations between various carcass traits and bone percentage in SMR fattening bulls (n= 617, hot carcass weight = 160 to 450 kg)

		Bones (%)
Hot carcass weight		- 0,705
Head	(%)	0,685
Four feet	(%)	0,630
Carcass length	(%)	0,744
Edible fat	(%)	- 0,695
Kidney fat	(%)	- 0,596

This indicates that fat may also be used as a rough predictor for the bone content. Bones may furthermore be regarded as the leftovers of the carcass after subtraction of meat and fat. Analogously to the meat/fat ratio, the interest then concentrates on the bone/fat ratio which is characterized by obviously favourable correlations of $r > 0,8$. It may be determined by dividing the bone parameters (head, feet, carcass length) by the fat parameter (kidney fat) as shown in Table 4.

Table 4. Ratio of various carcass traits and kidney fat (kg) as correlated with bone /fat ratio in SMR fattening bulls (n = 617)

Quotient	Ratio Bones (%)/ Edible fat (%)
Head (kg)/Kidney fat (kg)	0,800
Four feet (kg)/Kidney fat (kg)	0,820
Carcass length (cm)/Kidnea fat (kg)	0,826

CONCLUSIONS

Carcass grading must be principally based on

- traits and auxiliary traits which determine the carcass value and are measured at an exclusively objective scale of merit,
- the precise definition of the carcass quality on the basis of tissue groups.

The desired carcass quality is characterized by

- maximum lean percentage,
- optimum fat percentage,
- minimum bone percentage.

In consideration of the slaughtering technology, the accuracy and the expenditure of carcass measurements, suitable auxiliary traits have to be chosen to characterize the three tissue groups and must then be combined for the purpose of assessment. Further improvement of grading on a more objective scale of merit should be associated with the use of advanced methods of data processing.