Constructing an Index for Beef Characteristics in Dairy Cattle Based on Carcass Traits

J.H.J. van der Werf[1], *A.F. Groen*[2] *and G. de Jong*[3]

[1]ID-DLO, P.O. Box 65, 8200 AB Lelystad, [2] WIAS, P.O. Box 338, 6700 AH Wageningen
[3] kNRS, PO Box 454, 6800 AL Arnhem, The Netherlands

Summary

Carcass data on cattle are routinely collected from Dutch slaughterhouses for genetic evaluation of beef production capacity. Such data were used from slaughter cows, veal calves and beef bulls, all originating from dairy or dual purpose breeds. The aim was to develop an index for beef production traits in a dairy cattle population. Genetic parameters were estimated within the three categories of slaughter animals. Heritabilities for veal traits were small, varying from .02 to .12; and for slaughter cows they varied from .18 to .28. Economic values were determined from profit equations and discounted expressions. Traits on bulls were not frequently expressed, and therefore insignificant. Economic weights per unit of genetic SD were for veal largest for colour (-4.45) and for daily gain (12.76), and for slaughter cows for fleshiness (8.37) and for carcass weight (-17.83). Predicted response based on an overall index was highest for daily gain in veal. Genetic changes in cows were very sensitive to the economic weight for carcass weight and to genetic correlations. Generally, carcass weight in cows was decreased, and fleshiness could be either decreased or increased, depending on the parameters used.

Introduction

Since 1995 the Dutch system of cattle identification allows for routine collection at slaughter houses of data on cattle carcasses. This involves data on veal calves, beef bulls and slaughter cows. These animals originate from Dutch dairy herds, from cows of dairy and dual purpose breeds, and only for a small percentage (about 8%) from crossings with beef breeds. Selection on beef production characteristics based on carcass data might be worthwhile, given that about 20% of the income of dairy farmers originates from the sales of young calves and slaughter cows.

An index for beef production traits can be constructed based on estimated genetic, phenotypic and economic parameters for the traits involved. The aim of this study was to estimate these parameters, to construct such an index and compare the expected selection responses for individual traits, and finally, to determine the robustness of such an index for different parameters and assumptions.

Material and Methods

Data for this analysis had been collected at a number of slaughterhouses between January 1995 and May 1995. Of the original 300,000 carcass records, about 50% could not be used because the animals had no pedigree information, either because they had been imported (mostly calves), or because they were not herdbook registered. Data was analyzed for the different animal categories separately. After further editing (e.g. removing single progeny of sires, and cows with no matching lactation data), the number of records for slaughter cows was 29.692, origi-

nating from 947 sires, for veal calves there were 42.508 records from 1270 sires, and for beef bulls, there were 4870 records from 466 sires from dairy breeds. A muscularity score from the routine type classification (i.e. measured on live animals) was available for 7289 cows from 1217 sires. Fleshiness (FLESH) and fatness (FAT) were scored according to the EUROP classification system. These were transformed to numerical values ranging from 1 (lean) to 15 (muscular, fat).

Mean values for the traits are in Table 1. Parameters were estimated with REML, using a sire model, and with effects of age at slaughter and genetic group (percentage of Holstein, Dutch Friesian, MRIJ genes). For analysis of data on cows, there was a correction for stage of lactation (days post partum), and for cows and bulls, there was an effect of finishing herd and month of slaughter. For the analysis of veal data, correction was for the effects of age, breed, sex and the interaction of finishing herd * day of slaughter. Variance components for sire and residual effects were estimated by Restricted Maximum Likelihood and heritabilities and genetic correlations were derived from these. Genetic correlations between traits in different categories of animals were not computed. The limited time span of data collection (5 months) did not allow enough progeny on the same sire in the different categories.

For index calculations, breeding goal traits were defined for each category with their associated cumulative discounted economic values. These were derived from profit equations (Bekman and Van Arendonk, 1992). The economic value for carcass weight (in Dfl * animal^{-1} * kg^{-1}) in cows was derived as

$$\delta T/\delta CW = p_{cw} - (((EG + NFD * EM_p + (365*L - NFD - 60) * EM_a) * p_{fv})/DP)$$

where

p_{cw} = price per kg carcass
NFD = days of rearing period (2-22 mo)
EG = energy for daily gain per kg live weight
Em_p = energy per kg live weight for maintenance
L = age at slaughter
DP = dressing percentage
Em_a = energy for maintenance during lactation per kg live weight and
p_{fv} = the price of feed.

Economic weights per unit of genetic SD were for veal 1.21 for fleshiness, -0.15 for fatness, -4.45 for colour and 12.76 for daily gain, and for slaughter cows 8.37 for fleshiness, -4.19 for fatness and -17.83 for carcass weight.

The index included for all categories the traits FLESH, FAT and CW. For cows, muscularity was additionally measured on alive heifers, and carcass colour was additionally measured in calves. Index variables were EBV's based on progeny (10 slaughter cows, 180 veal calves and 20 beef bulls) at the time that the milk production data became available.

Results

Heritabilities for, and correlations between carcass traits are in Table 2. Heritabilities for veal traits were generally very low.

The reliability of the index using all beef and veal traits was about .80 and the standard deviation of the index was about Dfl. 13,-, which is about 10% of the SD of the index for milk production traits.

Results from information on traits from the different categories contributed to genetic change very differently. Selection based on only veal production traits mostly improves daily gain in veal. Fleshiness in veal and in cows is improved to a lesser extent, whereas carcass weight of cows increases (which was economically undesired). Selection for information only on cows leads to a decrease of carcass weight in cows, and cow and veal fleshiness as well as daily gain in veal decrease. Selection on a combination of information from all categories decreases weight on cows, hardly affects cow fleshiness, and improves fleshiness and daily gain in veal.

Correlations between traits in different animal categories have a large effect on genetic gain for individual traits, particularly in cows. High correlations between similar traits in different animal categories allow small changes of carcass weight (decrease) and fleshiness (increase) in cows, whereas an index based on low correlations would aim for a larger decrease of carcass weight as well as a decrease of fleshiness.

The economic weight for carcass weight of cows is sensitive to feed- and beef prices as well as for the length of productive life. A decrease of the economic weight of live weight in cows allows an increase of carcass weight and more change for fleshiness (Table 3). In the latter case, improvement of daily gain in veal calves accounts for about 70% of the total genetic gain obtained.

Reference

Bekman, H. and van Arendonk, J.A.M. 1993. Derivation of economic values for veal, beef and milk production traits using profit equations. Livest. Prod. Sci. 34, 35.

Table 1. Means, (SD within brackets) for carcass fleshiness, - fatness, - colour and - weight, and for age at slaughter for the different categories

Category	Fleshiness	Fatness	Colour	Weight	Age
Cows	4.53 (2.0)	8.11 (2.7)	-	310.9 (41.3)	-
Veal	4.70 (1.7)	6.89 (2.1)	5.2 (1.5)	159.6 (19.9)	207.6 (11)
Bulls	5.57 (2.1)	7.19 (1.6)	-	348.1 (52.3)	615.0 (110)

Table 2. Estimated heritabilities (diagonal) and genetic correlations (lower diagonal) for veal and beef production traits

Cows				
Fleshiness	0.19			
Fatness	0.34	0.18		
Carcass weight	0.61	0.32	0.28	
Muscularity	0.64	0.07	0.37	0.44
Veal				
Fleshiness	0.02			
Fatness	0.58	0.10		
Carcass weight	0.49	0.43	0.12	
Colour	0.05	0.09	0.17	0.10
Bulls				
Fleshiness	0.07			
Fatness	0.28	0.23		
Carcass weight	0.37	0.10	0.19	

Table 3. Relative genetic change per trait (in monetary units) using an index for beef and veal carcass traits, with varying economic value for carcass weight in cows

	Econ.weight carcass weight cows	
	-.924	-.462
Veal		
Fleshiness	.11	.12
Fatness	-.00	-.00
Colour	.08	.05
Daily gain	.41	.71
Bull		
Fleshiness	.02	.03
Fatness	.00	.00
Daily gain	.01	.06
Cow		
Fleshiness	.02	.19
Fatness	.07	.03
Carcass weight	.27	-.20