# An all breed genetic evaluation for beef traits in the Dutch/Flemish evaluation

*W.M. Stoop, L.C.M. de Haer, G. de Jong*
*CRV, P.O. Box 454, 6800 AL Arnhem, The Netherlands*
*E-mail: Marianne.Stoop@crv4all.com*

## Abstract

The Dutch/Flemish evaluation hasd recently been updated to an animal model including both Dutch and Flemish data, implemented in April 2012. The beef index is a good tool to apply for more specific cross breeding and to improve beef production in dual-purpose breeds by providing compact information of carcass traits. It is possible to compare bulls of different breeds with each other. The variation in beef index within a breed has overlap with other beef breeds.

## 1. Introduction

In 1998, the Dutch/Flemish evaluation introduced its first genetic evaluation for beef traits, with an overall index to rank the bulls. This sire model has recently been updated to an animal model including both Dutch and Flemish data, implemented in April 2012.

The beef index is meant for the dairy cattle farmer who, in his choice of active bulls, wants to take into account the expected surplus value of the (bull)calf for the veal calf and beef bull sector. In other words, the beef index provides the meat production value of the calf when utilised in the beef cattle sector, whereas the production index (based on kg milk, fat and protein) provides the milk production value of the (female) calf when utilised in the dairy cattle sector. Therefore, although we do have breeding values for meat production value for the dairy cow, these cow traits are not considered directly in the beef breeding goal, which is ultimately meant to improve veal calves and beef bulls. Another, more practical reason to omit cow traits in the index is the very difficult interpretation of the economic values of the slaughter traits for the dairy cow. The economic value of the weight of the animals is negative – the additional slaughter profits do not compensate for the additional maintenance costs during the entire productive life of the cow (Koenen et al., 2000).

The beef index can be utilized to:

- enable a more specific meat production suitability within dual-purpose breeds.
- provide compact information about the carcass quality and carcass weight of a bull's offspring.
- handle commercial crossbreeding in a more goal-oriented manner. The differences between bulls and breeds become apparent.

## 2. Material and Methods

### *2.1 Data*

Since January 1995 slaughter data are collected in Dutch slaughterhouses. Since January 2006 also data from Flemish slaughterhouses are available. Slaughter data of three animal groups are recorded: dairy cows, veal calves and beef bulls. Data editing rules for *veal calves*: the sex of the animal is male or female, the slaughtered weight is between 90 kg and 250 kg, the slaughter age is between 100 days and 250 days, and the meat colour has a score between 1 to 10; for *cows* the sex is female, the slaughtered weight is between 200 kg and 800 kg, the lactation stage is at most 550 days and the slaughter age is at least 600 days, the cow belongs to a dairy breed; for *beef bulls* the sex is male and the slaughter age is between 350 days and 850 days.

The data that are measured upon slaughtering are: carcass weight, degree of muscularity, degree of fat covering and meat colour. This last trait is only scored for veal calves.

The carcass weight is measured in kilograms with an accuracy of up to 0.1 kg. Besides the weighed carcass weight, a tare weight is given (for the meat hook, for example) and a correction weight (for late weighing, if any, of the carcass). After correction of the carcass weight for the tare weight and correction weight, the carcass weight remains, which is the determined warm slaughtered weight.

Muscularity is scored in accordance with the SEUROP system. This gives a valuation 'S' to a carcass with a large degree of muscularity and a valuation 'P' to a so-called "culled" dairycow. The official description of the categories is: S = superior degree of muscularity, E = excellent, U = very good, R = good, O = moderate and P = low. Per main category three subcategories are indicated by -, 0 and +. In this way, there are finally 18 codes for the degree of muscularity, such as E-, E0, E+, U-, etc. For the breeding value estimation, the 18 codes for the degree of muscularity are recoded for a scale of 1 to 18 incl., in which S+=18, ....., and P-=1.

The degree of fat covering is scored with figures 1 to 5 incl., in which the value 1 belongs to carcass with an extremely low degree of fat covering and a score 5 is given to a carcass with a very high degree of fat covering. The official description of the categories is: 1 = low degree of fat covering, 2 = light, 3 = average, 4 = high degree of fat covering and 5 = very high degree of fat covering. Per main category, another three subcategories are indicated by -, 0 and +. This leads to 15 final codes for the degree of fat covering, such as 1-, 10, 1+, 2-, etc. For the breeding value estimation, the 15 codes for degree of fat covering are recoded into 1 to 5 incl., in which 1- = 1 and 5+ = 15.

**Table 1.** Averages for the traits of degree of muscularity, degree of fat, meat colour, carcass weight, slaughter age and lactation length at slaughter for the data used in the breeding value estimation

| | veal calves | | cows | | beef bulls | |
|---|---|---|---|---|---|---|
| Trait | | | | | | |
| muscularity | O 0 | | O - | | O + | |
| fat | 2 0 | | 3 - | | 3 - | |
| meat colour | 6 | | --- | | --- | |
| carcass weight | 144 kg | | 293 kg | | 362 kg | |
| age at slaughter | 196 days | | 2011 days | 5y6m | 613 days | |
| lactation length at slaughter date | | | 260 days | | | |

Meat colour is scored in 15 categories, score 1 to 15 incl., in which a higher value corresponds with a darker colour. The first 10 categories are meant for the white veal calves, the last 5 categories are for the so-called pink veal calves.

Observations are available for 5,348,144 calves, 3,606,529 cows and 336,172 bulls. Table 1 gives the trait averages per animal group (calves, cows and bulls).

In the breeding value estimation, breeding values for three animal categories are estimated: for the culled cows breeding values are estimated for degree of muscularity, degree of fat covering and carcass weight, for the beef bulls breeding values are estimated for degree of muscularity, degree of fat covering and growth, and for the veal calves breeding values are estimated for degree of muscularity, degree of fat covering, meat colour and growth. This may result in a total of 10 breeding values per animal in the genetic evaluation. In april 2012, a total of 13,678,423 animals received breeding value for beef index.

*2.2 Model*

The calculation of breeding values is done with a multiple trait animal model, in accordance with the BLUP technique (Best Linear Unbiased Prediction). Using this method, breeding values for all animals of all breeds, males and females, are estimated, making use of all slaughter data of animals and their ancestors, and making use of the correlation between traits.

The model for the analysis of the data of the white veal calves is as follows:

$$\mathbf{Y_{ijklmno} = BS_i + b_j{*}AGE_j + b_k{*}HET_k + b_l{*}REC_l + SEX_m + ANIMAL_n + Residual_{ijklmno}}$$

For culled cows:

$$\mathbf{Y_{ijklmnop} = BS_i + AGE_j + b_k{*}HET_k + b_l{*}REC_l + M_m + b_n{*}LACT_n + ANIMAL_o + Residual_{ijklmnop}}$$

For bulls:

$$\mathbf{Y_{ijkmno} = BS_i + b_j{*}AGE_j + b_k{*}HET_k + b_l{*}REC_l + ANIMAL_m + Residual_{ijkmn}}$$

In which:

$Y$ = observation of the animal for degree of muscularity, degree of fat covering, meat colour and carcass weight;

$BS_i$ = herd*slaughter date i of the animal n;

$b_j$ = regression factor $b_j$ at age of the animal at slaughter, with the linear, quadratic and cubic term;

$AGE_j$ = slaughter age of animal n (in days for veal calves and bulls, in half year classes for cows);

$b_k$ = regression factor $b_k$ to the heterosis effect, linear term;

$HET_k$ = heterosis effect k of the animal, in which some six effects are distinguished: heterosis between two dairy breeds, heterosis between a dairy breed and a dual-purpose breed, heterosis between a dairy breed and a beef breed, heterosis between a dual-purpose breed and a beef breed and heterosis between two beef breeds:

$b_l$ = regression factor $b_l$ to the recombination effect, linear term;

$REC_l$ = recombination effect l of the animal, is which some six effects are distinguished: recombination between two dairy breeds, re-combination between a dairy breed and a dual-purpose breed, recombination between a dairy breed and a beef breed, recombination between a dual-purpose breed and a beef breed and recombination between two beef breeds;

$SEX_m$ = sex m of the animal;

$ANIMAL_{n/o/m}$ = animal genetic effect;

Residual = residual of Y , which is not explained by the model.

$M_m$ = month m of slaughter of the animal, in which month is defined as year*month;

$b_n$ = regression factor $b_n$ on lactation stage of the animal at slaughter, with both the linear and the quadratic term;

$LACT_n$ = lactation stage at slaughter of animal (in days).

The heritabilities and correlations used are stated in table 2.

*2.3 Beef Index*

In the calculation of the beef index, the breeding values of the bulls are weighted in accordance with the reliabilities belonging to these breeding values.

Furthermore, the correlations between traits are used as stated in table 2.

**Table 2.** Overview of correlations between traits and animal groups. Heritabilities (diagonally), genetic correlations (bottom diagonally) and fenotypical correlations (top diagonally) between traits for the animal groups culled cows, veal calves and beef bulls, as used in the beef index. The traits are degree of muscularity, degree of fat, growth (gram/day) or carcass weight (kg), and meat colour for veal calves.

| | culled cows | | | veal calves | | | | beef bulls | | | genetic variance |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | musc | fat | carc | musc | fat | growth | colour | musc | fat | growth | |
| musc | **0.18** | 0.64 | 0.66 | | | | | | | | 0.29 |
| fat | 0.52 | **0.17** | 0.63 | | | | | | | | 1.17 |
| carc | 0.53 | 0.36 | **0.23** | | | | | | | | 289.50 |
| musc | 0.53 | 0.12 | 0.11 | **0.25** | 0.45 | 0.65 | -0.02 | | | | 0.30 |
| fat | 0.11 | 0.41 | -0.08 | 0.51 | **0.17** | 0.60 | -0.02 | | | | 0.59 |
| growth | 0.16 | 0.02 | 0.37 | 0.59 | 0.55 | **0.20** | 0.03 | | | | 49.00 |
| colour | 0.03 | 0.14 | -0.08 | 0.05 | 0.08 | 0.06 | **0.19** | | | | 0.25 |
| musc | 0.78 | 0.29 | 0.29 | 0.72 | 0.15 | 0.20 | 0.06 | **0.34** | 0.20 | 0.51 | 0.26 |
| fat | 0.13 | 0.58 | 0.03 | 0.23 | 0.61 | 0.12 | 0.13 | 0.25 | **0.30** | 0.35 | 0.40 |
| growth | 0.38 | 0.17 | 0.63 | 0.35 | 0.06 | 0.51 | -0.03 | 0.48 | 0.19 | **0.19** | 161.00 |

The economic values used in the beef index have been deduced in a research of Van der Werf (1996 and 1998) and are mentioned in table 3. The various traits in the various animal categories do not express to the same degree and at the same point of time. In order to calculate the value of genetic improvement for the various traits back to a common basis, they may be multiplied by a so-called cumulative discounted expression (CDE). In the CDE of a trait, the time and frequency are allowed for of a superior genotype, resulting from the selection of an individual in a breeding program. Mortality is also taken into account here. As allowance factor an interest percentage of 3% per year has been assumed. In the calculation of the CDEs, expression of slaughter trait for veal calves and beef bulls has been assumed at the slaughter age of 200 and 600 days, respectively. Calves that are born have some three destinations that affect the cumulative expressions of the slaughter traits: calves serve as replacement of dairy cattle, enter the beef calf sector or go to the beef bull sector. Of all the calves born, 30% finally becomes a dairy cow. To this end, 45% of the calves born are required in the dairy cattle sector so that, having taken into account drop-out around birth and death during the rearing, 30% realise complete heifer lactations. The bull calf sector takes 50% of the calves for its account, while 5% of the calves from dairy cattle are kept and slaughtered as beef bulls.

**Table 3.** Economic values and the cumulative allowed economic value (= value used in the beef index) of slaughter traits, used for the breeding goal traits of the beef index.

| Trait | economical value | 1) cumulative discounted economical value |
|---|---|---|
| *veal calv.* | | |
| fleshiness | 5,03 | 2,74 |
| fat covering | -0,21 | -0,116 |
| growth | 0,227 | 0,124 |
| meat colour | -8,29 | -4,52 |
| *beef bulls* | | |
| fleshiness | 17,82 | 1,27 |
| fat covering | -3,49 | -0,185 |
| growth | 0,452 | 0,024 |

* economical values in €/subcategory

The expression of meat production traits is taken relatively to the expression of milk production traits, so that the beef index may be compared with the production index. Of all the calves born, 30% give 1/0.3 times expression to milk production. The expression of milk production is relative 1 at heifer level, at which the production index is expressed, and as second and higher parity cows produce more, the relative expression of milk has been determined at 1.179. This has resulted in cumulative allowed economic values as stated in table 3 and as they are also used in the beef index. The standard deviation of the beef index at breeding value level is € 5,57 expressed in the lactation production of a heifer. To still be able to compare the importance of the beef index in relation to the production index, the economical value is determined on the basis of the prices of 1995 (Van der Werf). In the determination of the standard deviation, the starting point is breeding values with a reliability of 80%. So 4 points in the breeding value correspond with approximately 0.9*genetic standard deviation. The standard deviation of the production index in euro's is approximately 18 times bigger than the standard deviation of the beef index.

## 3. Conclusions

The beef index is a good tool to apply for more specific cross breeding. It gives information about carcass quality and carcass weight of the offspring of a bull. At the same time it is possible to compare bulls of different breeds with each other. The variation in beef index within a breed has overlap with other beef breeds (see figure 1). This immediately shows the value of the beef index for a dual-purpose breed as MRY, but also for the (bull) calves within the dairy sector. Furthermore,

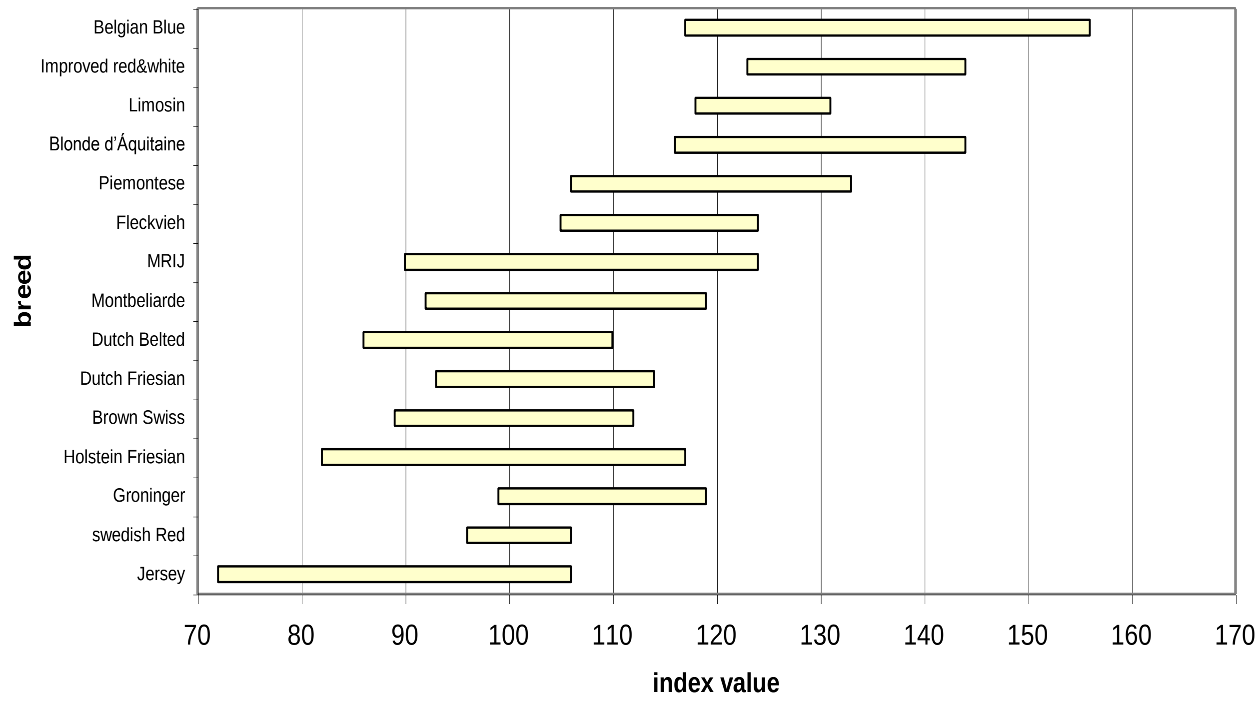


**Figure 1.** Variation of beef index within a breed and the overlap which exists between breeds.

figure 2 shows that the beef and dairy breeds have a stable genetic trend, whereas for dual purpose breeds focus has been more on dairy, than on beef, resulting in aa negative genetic trend. It is now possible to breed selectively for beef production suitability on the basis of the beef index.

## 4. References


Koenen, E.P.C., P.B.M. Berentsen, and A.F. Groen, 2000. Economic values of live weight and feed-intake capacity of dairy cattle under Dutch production circumstances. Livest. Prod. Sci. 66: 235-250.

Van der Werf, J.H.J., E.H. van der Waaij, A.F. Groen, G. de Jong and H. Bekman, 1996. Fokwaardeschatting voor vleesproduktiegeschiktheid op basis van slacht-gegevens van nakomelingen. ID-DLO report no. 96.007. *(Breeding value estimation for meat production suitability on the basis of slaughter data of offspring)*

Van der Werf, J.H.J, E.H. van der Waaij, A.F. Groen and G. de Jong, 1998. An index for beef and veal traits in dairy cattle based on carcass traits. Livest. Prod. Sci. 54: 11-20.

Jong, de G, 2008. Genetische parameters voor slachtkenmerken bij melkkoeien, vleeskalveren en vleesstieren. CRV rapport nr. R&D/08.0067. (*Genetic parameters for slaughter traits at dairycows, veal calves and beef bulls)*


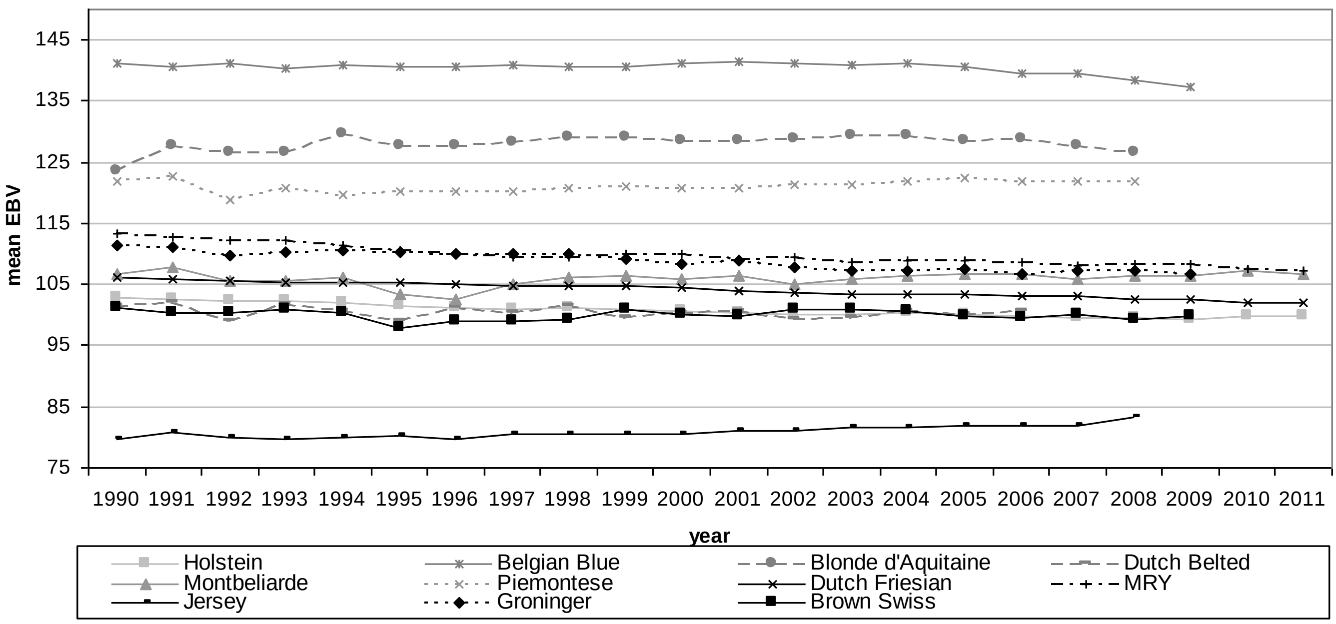


**Figure 2.** Genetic trends for beef index within cows of a breed and differences between breeds.