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EVALUATION OF INDUSTRY BREEDING PROGRAMS FOR DAIRY CATTLE
MILK AND MEAT PRODUCTION

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Munich University of Technology
D-8050 Freising, FRG

SUMMARY

In most European dual purpose breeds beef merit is paid attention to by selection among performance tested bulls where comparatively much weight is given to growth rate of performance tested bulls and relatively little weight to muscling and thus to carcass meat content. The genetic correlation between beef and dairy merit appears to be negative. This, in combination with large and effective selection pressure on milk leads to negating the effects of the little and relatively inaccurate selection for beef merit at the best. Field progeny testing for beef merit can be economical and will permit to neutralize or even improve the beef merit of dual purpose cattle without much reduction in genetic progress of dairy merit.

In dual purpose cattle breeds milk and meat are of roughly equal importance, i.e. the minor trait should not contribute less than some 20 - 25 % to the total income. The selection objectives for dairy traits are clearly defined and there exists a close correspondence with selection criteria such as lactation or part lactation yield. The selection objective in case of beef production is the quantity of lean meat or the efficiency of lean meat production. However, the selection criteria are numerous and they need to be included in fairly complex prediction equations. Frequently their commercial relevance is not obvious. Also, prospective feeder animals are usually marketed very early - frequently at an age of one week - where the fattening quality can be poorly appraised and no or little price differentiation is practiced.

INTRODUCTION

Organized breed improvement for dairy performance is well established. Progeny testing of bulls for milk yield became general after WW II. The selection schemes are all based on progeny testing and they are fairly standard in all major dairying areas. In contrast testing of bulls for their genetic merit for beef production is comparatively new and less developed. The approach taken varies widely between and even within European countries. One reason for this discrepancy between testing for beef and dairy merit is the comparative ease with which size, and therefore growth, and muscling can be judged on the live animal. In contrast, dairy performance not only is sex-limited but even in females accurate appraisal requires measuring the milk yield. Therefore, objective and systematic milk recording has been instituted rather early while for meat performance one was satisfied with visual appraisal, in some cases right up to the present. Nevertheless, before the advent of progeny testing for milk the accuracy
of estimating the genetic merit for milk and beef was not very different.

In all European countries some improvement schemes for beef production in dual purpose breeds are in operation. The improvement rests mostly on performance testing of young bulls. On a rather limited scale progeny testing is also practiced either in stations or on field records. Since station testing incurs rather large expenses it is reserved, in general, for performance testing. In the EC there are in excess of 5,000 places, in the Comecon countries (except the Soviet Union) some 6,000 places available for performance testing of young bulls for meat production. However, animals are often grouped and then no feed consumption records are collected. Also a large proportion of young bulls is still bought either in auctions or directly from breeders' herds.

Station progeny testing is carried out in some countries on a limited scale and slaughter data are available. In some countries the progeny testing for meat production is reserved for the selection of future bull sires (Pribyl et al., 1984). In Bavaria the progeny test capacity suffices for some 15% of the bulls (Averdunk, 1984) and in Denmark the best 30 of the 120 progeny tested (for milk) bulls are subjected to a progeny test for beef performance (Andersen, 1982).

**METHODICAL PROBLEMS**

Testing for beef performance involves several problems, some of which shall be briefly discussed. Most of these are relevant to testing for beef performance in general while the genetic connexion between meat growth and dairy performance is special and in some way central to dual purpose breeding.

As mentioned above performance testing frequently involves only measuring the growth rate and, possibly, appraisal of muscularity either by scoring or by ultrasonic measurement. A European working group (Andersen et al., 1981) has outlined how the feeding regime in the test period influences components of lean tissue growth (LTG). In the pertinent production areas concentrate feeding is restricted while roughage is offered ad libitum. However, the level of concentrate feeding is fairly high so that LTG and residual feed conversion efficiency should receive considerable selection pressure.

For termination of the testing period three alternatives are possible: 1) age constant termination 2) weight constant termination and 3) testing to constant finish. At Clay Center (Smith et al., 1976) the three methods were compared and methods 1) and 2) were shown to be biased in favor of large sized, late maturing cattle. When comparison was made at equal degree of fatness the bias was absent. Also marketing of cattle occurs at comparable degree of finish. Therefore method 3) should be favored in testing or the records should be corrected to equal finish.

The correlation between size and muscularity on one hand and calving ease on the other is negative for direct and, somewhat less, for maternal effects (Fewson, 1985).

A problem general to all station testing concerns the possible interaction between environments and genotypes. Since testing of young bulls at stations is comparatively popular, care must be taken to avoid serious interactions. However, if progeny testing for beef traits carried out in the field should be of less importance if the genetic connexion between meat and milk yield is utilized. British heifer muscling scores are of bulls. In contrast B1 genotypes (breeds and twinning) are of dual purpose Friesian or production of Holstein genetic composition and if public lean are corrected for the dairy performance of the animals.

### Table 1

**Genetic Connexion between**

<table>
<thead>
<tr>
<th>Correlation of Dairy Performance</th>
<th>Meat/Bone Ratio</th>
<th>Meat/Carcass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat/Bone Ratio in Hind legs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat Gain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% 4-legs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Performance Differences of Meat/Bone Ratio</th>
<th>LTG, g/d</th>
<th>Milk Yield, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) computed from results of Stolzman et al. (1978)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) genotypes in % carcass fat. Kögel et al. 1978.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) D - de Boer et al. 1967.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Another possibility between meat and milk yield in America. This is considered as correlated for milk yield in America. The genetic parameters which are considered as correlated are:

- Genetic parameters which are: muscle content and again...
milk and beef was not very
good. However, some improvement schemes for
raising the quality of young bulls is also practiced in the
former Comecon countries. For instance, testing for
young bulls is still carried out in the field at research
institutions. However, station testing incurs rather
high costs (some 6 000 places available for young bulls) and,
therefore, several studies were concerned with the comparison of breeds,
species, and crosses, such as the Polish FAO Friesian comparison
(Relewski, 1982). A number of other comparisons mostly of European
dual purpose Friesian or Red and White cattle with US-Holsteins
were published (O’Ferrall, 1982). There is consensus that intro­
duction of Holstein genes or of Brown Swiss genes impaires carcass
composition and if published data on meat-%, meat growth and car­
cass lean are corrected to equal fatness, their correlations with
the dairy performance of the genotypes are negative (Table 1).

Table 1
Genetic Connexion between Dairy and Beef Merit

<table>
<thead>
<tr>
<th>Correlation of Dairy Performance with Meat/Bone Ratio</th>
<th>Milk Yield, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat/Bone Ratio</td>
<td>-0.36</td>
</tr>
<tr>
<td>Meat/Carcass</td>
<td>-0.26</td>
</tr>
<tr>
<td>Meat/Bone Ratio in Hindquarter</td>
<td>-0.40 Mason et al.</td>
</tr>
<tr>
<td>Meat Gain</td>
<td>-0.38 Suess et al.</td>
</tr>
<tr>
<td>% 4-legs</td>
<td>0.40 Rutzmoser</td>
</tr>
</tbody>
</table>

Performance Differences of Dairy (D) and Dual Purpose (DP) Breeds

<table>
<thead>
<tr>
<th>LTG, g/d</th>
<th>2)</th>
<th>3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D - DP</td>
<td>-17</td>
<td></td>
</tr>
<tr>
<td>Holstein - Braunvieh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown Swiss - Braunvieh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black and White - Braunvieh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dutch Friesian - Dutch Friesian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>de Boer et al. 1967.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Another possibility of estimating the genetic correlation
between meat and milk yield is provided by the comparison of the
respective performances of the American dairy breeds Holstein-
Friesian and Brown Swiss with their European parent breeds (Black-
and-White, Braunvieh). The changes in carcass composition can be
considered as correlated response to nearly exclusive selection for
meat yield in America. Therefore a realized genetic correlation may
be estimated. Again it turns out to be strongly negative, somewhere
between -0.3 and -0.6, depending on the assumptions about the other
genetic parameters which are necessary for the estimation. Several
auxiliary criteria are correlated rather closely with the carcass
muscle content and again they all are negatively correlated with
dairy performance (Table 1). In contrast to the near consensus of most published estimates of meat–milk correlations there is considerable variability among the published correlations between growth rate and dairy performance. However, these are small, either slightly negative or slightly positive. Some of the differences could be due to the different ways of determining growth rate – to fixed age, weight or finish, with ad lib or under restricted feeding. However, no investigation of the consequences to the correlation of measures taken in different ways, is available.

**EUROPEAN IMPROVEMENT SCHEMES**

In most European countries testing for beef merit of dual purpose bulls consists of performance testing for growth rate and sometimes muscularity and only rarely is this information supplemented with progeny tests and if so these are not infrequently based on heifer progeny. The first selection involves culling of roughly one half of young bulls on the basis of the performance test or of an index combining the dairy performance of dam and half-sisters with growth rate and in some cases muscularity of the tested bulls themselves. In table 2 the relative contribution of various traits to the index is given. The contributions were computed by multiplying the published weights times the genetic standard deviation or the standard deviation of the indices. In most instances the indices refer to the selection of progeny tested bulls which obviously had been selected in a first stage on their own performance. The German indices are destined to select young bulls which in a second stage are selected according to their progenies' dairy performance. However, when young bulls have been through a performance test and the remainder ranked through the same selection intensity (Wismans, 1984). In Denmark 1/3 of the performance test of young bulls is given in table 3. The culling rates of 80% or more are given. In most countries selecting young bulls for dairy merit is not very high. The various in i.e. information on milk index and vice versa. The methods are compared in table 3 for which traits, similar to those used in genetic and phenotypic correla and milk fat yield and muscle scores and milking schemes are a three step empirical index as and D are two-stage selection schemes for which, similar to those used in genetic schemes, are a three stage index selection of young bul geny tests for dairy performance. 1) is selection of young bulls, independent culling for beef merit test selection for milk fat yield and muscularity. Selection also with an optimal index change, not even in young bulls, can be greater but addition into account. After the preparation for AI. A summary is given as evidence for dairy performance.

**Table 3**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Denmark</th>
<th>Finland</th>
<th>Germany</th>
<th>Norway</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight gain</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Conformation</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Milk Yield</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fat Yield</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Fertility</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Udder</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
</tbody>
</table>

1) Including semen quality. Source: Pribyl et al. 1984

The various in i.e. information on milk index and vice versa. The methods are compared in table 3 for which traits, similar to those used in genetic and phenotypic correlation schemes are a three step empirical index as and D are two-stage selection schemes for which, similar to those used in genetic schemes, are a three stage index selection of young bulls, independent culling for beef merit test selection for milk fat yield and muscularity. Selection also with an optimal index change, not even in young bulls, can be greater but addition into account. After the preparation for AI. A summary is given as evidence for dairy performance.

Separate selection also with an optimal index change, not even in young bulls, can be greater but addition into account. After the preparation for AI. A summary is given as evidence for dairy performance.

### Table 2

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Denmark</th>
<th>Finland</th>
<th>Germany</th>
<th>Norway</th>
<th>Sweden</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>32</td>
<td>52</td>
<td>47</td>
<td>61</td>
<td>30</td>
</tr>
<tr>
<td>Beef</td>
<td>23</td>
<td>8</td>
<td>42</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Milkability</td>
<td>3+</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Conformation</td>
<td>37</td>
<td>5</td>
<td>11</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Fertility</td>
<td>7</td>
<td>16</td>
<td>10</td>
<td>10</td>
<td>0.3</td>
</tr>
<tr>
<td>Calving Ease</td>
<td>6</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Disease</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Temperament</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


**FV Fleckvieh**

**HF German Friesians**

various traits to the index is given. The contributions were computed by multiplying the published weights times the genetic standard deviation or the standard deviation of the indices. In most instances the indices refer to the selection of progeny tested bulls which obviously had been selected in a first stage on their own performance. The German indices are destined to select young bulls which in a second stage are selected according to their progenies' dairy performance. However, when young bulls have been
to the near consensus is that the minor correlations that have been estab-
lished correlations between growth rate, milk fat, and milk production. Some of the differences in the data may be due to the methods used for determining growth rate and milk or under restricted feeding, and the consequences to the cost and time required for these investigations is available.

ROVEMENT SCHEMES

Schemes testing for beef merit in beef populations are rare, and rarely is this information available. In some cases, selection for beef merit is included in a performance test on a station. In the Netherlands about 40% to 50% are culled through a performance test on a station, and the remainder ranked by index. In the Netherlands about 40% to 50% are culled and the remainder ranked by index. In the Netherlands about the same selection intensity is applied to performance in stations (Wismans, 1984). In Denmark about 20% and in East Germany about 1/3 of the performance tested bulls enter AI service as test bulls (Wolfe, 1984). In table 3 the culling rates which are applied in the CSSR are given. In model calculations Fewson (1985) found cul-
ing rates of 80% or more optimal.

Table 3  
Culling Rates in CSSR Breeding Program

<table>
<thead>
<tr>
<th>Performance Test</th>
<th>Progeny Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull Sires</td>
<td>Proven Bulls</td>
</tr>
<tr>
<td>Weight gain</td>
<td>29</td>
</tr>
<tr>
<td>Conformation</td>
<td>12.5</td>
</tr>
<tr>
<td>Health</td>
<td>13.4</td>
</tr>
<tr>
<td>Milk Yield</td>
<td>65</td>
</tr>
<tr>
<td>Fat %</td>
<td>10</td>
</tr>
<tr>
<td>Fertility</td>
<td>14</td>
</tr>
<tr>
<td>Milkability</td>
<td>5</td>
</tr>
<tr>
<td>Udder</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

1) including semen quality, 2) carcass gain of progeny. Source: Pribyl et al. 1984.

The various indices are usually computed independently, i.e., information on milk is disregarded when computing the beef index and vice versa. The efficiency of the various selection methods are compared in table 4 on hand of four partly abstracted schemes for which traits, genetic parameters and economic weights are as used in Germany were utilized. However, the genetic and phenotypic correlations between growth rate on one hand and milk fat yield and muscle scores on the other, were assumed to be zero and 0.2, respectively, while the genetic correlation between muscle scores and milk yield is taken to be -0.3. The selec-
tion schemes are a three stage selection (A), selection according to an empirical index as used for German Fleckvieh (B), an optimal index (C) and no selection for beef traits (D). The variants B, C, and D are two-stage selection schemes where stage one involves index selection of young bulls and stage two selection based on pro-
geny tests for dairy performance, respectively. In scheme A stage 1 is selection of young bulls for dairy merit, stage 2 involves independent culling for beef performance and stage 3 finally pro-
geny test selection for milk yield. For all schemes it is assumed that 10% of young bulls are retained on account of estimated dairy merit and beef performance. Of course, selection intensity can be greater but additional traits probably need to be taken into account. After the progeny test 20% of the bulls are re-
tained for AI. As is evident from the figures given in the table selection for dairy performance impaires muscling.

Separate selection for muscling as in scheme A but also with an optimal index cannot neutralize this indirect genetic change, not even in young bulls where accuracy of estimating dairy merit is not very high. The exception is scheme B patterned after the index of the Bavarian Fleckvieh. In all cases progeny test

Table 4
Breeding Values of Bulls

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>Σ</td>
<td>1</td>
</tr>
<tr>
<td>Milk Fat (F), kg</td>
<td>9.7</td>
<td>-.7</td>
<td>12.9</td>
<td>21.9</td>
<td>7.7</td>
</tr>
<tr>
<td>Growth Rate (GR), kg/d</td>
<td>.046</td>
<td>.046</td>
<td>.046</td>
<td>.060</td>
<td>.067</td>
</tr>
<tr>
<td>Muscling Scores (MS)</td>
<td>-.18</td>
<td>.18</td>
<td>-.22</td>
<td>-.22</td>
<td>-.11</td>
</tr>
<tr>
<td>Σ</td>
<td>65.8</td>
<td>68.5</td>
<td>70.2</td>
<td>75.4</td>
<td>82.5</td>
</tr>
</tbody>
</table>

A 3-stage selection, stage 1, i=1.4 based on dam's (3 lactations) and half-sisters' dairy performance (n=50), stage 2 beef performance test, i=1, stage 3 progeny test for dairy performance, i=1.4. B 1 Selection according to index for German Fleckvieh, i=1.75, 2 as 3, i=1.4. C 1 Optimal young bull index, i=1.75, 2 as 3. D Selection for dairy performance only, i=1 as 1 but i=1.75, 2 as 3. E 1** as 1, 2** optimal progeny test index, i=1.4.

Table 5
Accumulated Profits (DM) from Beef Testing

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>GR</th>
<th>MS</th>
<th>Σp</th>
<th>economic weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>rG</td>
<td>.25</td>
<td>0</td>
<td>-.3</td>
<td>.2</td>
<td>2.43</td>
</tr>
<tr>
<td>rp</td>
<td>0</td>
<td>.40</td>
<td>.2</td>
<td>.12</td>
<td>330</td>
</tr>
<tr>
<td>h² on diagonal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D, C, E as in table 4, c accumulated, discounted profit per cow, in DM, d accumulated, discounted profit of 20,000 inseminations, 8,700 lactations, 8,700 slaughter animals, in 1,000 DM. Realizations of dairy and beef expressions over 12 years.

1984, Andersen (1982) that selection for dual purpose bulls is carried through all selection schemes, where the zero correlation of the dual purpose scheme D makes it obvious that selection for dairy performance must be carried through all selection schemes. This is due to the fact that the dairy merit, and leads to a not negligible selection differential. In contrast impure selection for dairy performance is met as a consequence of the zero correlation of the dairy scheme, where no performance for dual purpose is selected. This is due to about half as much as is suitable for dual purpose. The small changes, in case of scheme C, are due to the fact that selection for dairy performance is not met as well. In scheme D, where no performance for dual purpose is selected, the reduction is about half as much as is suitable for dual purpose.
Selection for dairy performance has a clear detrimental effect on muscle score. In contrast, improvement of growth rate of the young bulls is carried through all stages of selection which is of cause a consequence of the zero correlation assumed. However, comparison of scheme D, where no performance test selection is considered with the other schemes makes it obvious that young bull selection for growth rate and muscling reduces the impairment of muscling score to about half as much as is suffered by exclusive selection for dairy merit, and leads to a noticeable improvement in growth rate. If the traits are weighted by the relative economic values used in German Fleckvieh the total improvements of the four schemes are 65.8, 68.5, 70.2 and 55.4 units, respectively.

All three dual purpose schemes are superior to the single trait scheme by nearly 20 % because the improvement in growth rate and the reduction in impairment of muscling outweigh the value of the reduction of genetic gain in milk fat yield. The use of the optimal index C leads to the largest benefit but the empirical Fleckvieh index is not very much inferior. If dual purpose selection uses, in addition to dairy traits, growth rate as the sole beef trait, the deterioration of muscling is expected to be considerably larger than if this has a separate weight, even under our comparatively favorable assumptions about the correlation matrix. Danish experience (Andersen, 1982) is that selection for growth rate impairs dressing-% and muscling.

Selection for muscling and for growth rate will impede calving ease. In several countries attempts are made to control undesirable developments in the calving process by restricting changes in gestation length which serves as proxy for calf birth weight (Wismans, 1984, Andersen, 1982). For our examples we have assumed genetic correlations of -0.3 and -0.1 between muscling score and growth rate on one hand and calving ease on the other, this being considered as maternal trait. The correlations with the direct effect would be similar if not more undesirable. However, direct effects could be controlled largely by mating heifers to specially selected bulls. Changes in growth rate and muscling brought about by selection schemes A, B, C should change calving ease by 0.034, 0.019 and -0.015 points on a scale with σ=3 and h²=0.1. The small changes, in case of three stage selection and of the optimal index selection positive, in case of the Fleckvieh index negative, are a consequence of the impairment of muscling scores which in turn derives from the rather large and effective selection pressure on dairy performance.

PROGENY TESTING

It is evident and corroborated by experience (Wismans, 1984, Andersen, 1982) that selection for dairy performance and crossing to dairy strains will impair the carcass muscle content. Selection of young bulls on estimates of their own muscle content is insufficient to counteract the very effective selection pressure for milk. In practically all improvement schemes both pressure and accuracy of selection for beef traits are much less than for milk yield (culling rates ca. 50 %, rMG ≈ 0.6, respectively, for beef traits vs. 10 to 20 % and rMG > 0.8 for progeny performance of milk yield, respectively). Obviously nearly all testing resources are allocated to milk recording and progeny testing for dairy traits.
and few means are reserved for testing meat traits. Now progress in the traits will depend very much on the extent and quality of recording and evaluation of collected information and only partially on the economic value of the traits. The reason for the lack of more attention to beef traits is historical to some extent but mainly it is caused by the experience and opinion of breeders that returns from dairy improvement are greater than from beef improvement, which of course gets the question back to the economics.

The efficiency of progeny testing for beef performance is indicated in col. E of table 4. It is assumed that beef performance was tested on 30 progeny in the field which has, as consequence, a lower heritability of growth rate \(h^2 = 0.16\) than station testing. However, the heritability of muscling scores was assumed to be equal to that of station test \(h^2 = 0.4\). Selection according to an optimal index comprising progeny averages for milk fat yield, growth rate and muscling scores is assumed. The variances and covariances are corrected for previous selection. As is evident, the genetic merit for muscling score of the bulls is improved a little in spite of the negative genetic connexion with milk fat yield, growth rate and muscling scores is assumed. Therefore, one may question why cows and their replacement have been devoted to the beef component.

Another possibility would be the application of restricted indexes (Kempthorne and Nordskog, 1959, Niebel and Van Vleck, 1983) or of a desired gain index (Pesek and Baker, 1969). However, they lead to rather large reductions in overall genetic gain if the accuracy of ascertaining the trait to be restricted is comparatively small.

EFFICIENCY OF TESTING

The feasibility of testing for beef merit is not infrequently questioned. For example Wisman (1984) quotes a benefit/cost ratio of only 8.4 for beef improvement of Dutch cattle in contrast to such a ratio of 180 for dairy improvement. However, Cunningham and Moioli (1982) find much more favorable ratios under Irish conditions. They quote benefit/cost ratios of 21 and 12 for performance test and subsequent progeny test for beef merit and 27 for dairy progeny test. If beef merit is improved only by performance test the benefit/cost ratio is 33 compared to 28 for dairy progeny test. Glaser et al. (1985) find that beef performance testing causes less than 10 % of costs but contributes between 1/4 and more than 1/3 of the genetic gain in breeding programs. Inclusion of beef progeny testing adds between about 1/10 and 1/6 of costs of breeding programs without attention to beef merit but its contribution to genetic gain can be between 40 and almost 50 %.

In table 5 the benefits accruing from some of the improvement programs for beef merit outlined in table 4 are indicated. The genetic improvements calculated in this are utilized and the following returns over feed costs are assumed: 1 kg butterfat 5 DM, 1 g daily gain 0.679 DM and one point of muscling score 24.70 DM. These values were derived from the relative importance attributed to the traits in the German Fleckvieh index. The returns are computed for 20 000 inseminations of one bull. It is assumed that 56 \% of the inseminations result in productive offspring and that for each birth 0.1 g daily gain 0.679 DM. This results in 8700 discards and a number of slaughter animals. As costs of breeding programs without attention to beef merit but its contribution to genetic gain can be between 40 and almost 50 %.

CONCLUSION

It has been shown that the benefit/cost ratio for beef progeny testing in the field relative to no beef progeny testing is about 150 DM for performance testing only. Further, the benefit/cost ratio is about 210 DM for performance testing relative to no beef progeny testing. Glaser et al. (1985) quote 150 DM for progeny testing. However, testing is carried out on a contract basis and the benefit/cost ratio is about 210 DM for progeny testing in the field. Therefore, one may question why cows and their replacement have been devoted to the beef component.

One problem is inherent in many areas at very young age in beefing qualities cannot be realized. However, there are exceptions, e.g. the genetic correlation of nearly 0.4 between one week old calves and carcass live weight. When calves are sold after four months as is common in Bavarian and more favorable (Schild et al., 1984) before killing system where the potential beef merit is ascertained should make obvious the estimation of the beef merit.

Another reason for the selection of the beef merit is the correlation in improvements in dairy merit. For example, genetic variance of beef merit and Philipsson (1984) estimates 10 % of the variance of beef merit index and only 6.8 and 19 % are devoted to indices for meat, fertility and other traits. On the other hand, Glaser et al. (1982) have nearly 50 % of the genetic progress contributed to beef improvement and as well as the figures given by 0.6 point to rather larger influence of beef merit.

The discrepancy between the figures can be explained by the inadequacies of recording systems and reflect only little of differences due to the relative low weight gain, therefore to lean content in the meat.

Our knowledge of the genetic contributions to lean muscle and beef merit is clearly wanting.
testing meat traits. Now progress in the extent and quality of information and only partly due to the relative low weight given to carcass conformation and the same number of slaughter animals. As costs for beef testing are assumed 1 200 DM for performance testing of a young bull and 15 DM per animal for progeny testing in the field (Schild, 1985).

The benefit/cost ratios are above 20 in case of performance testing relative to no beef testing at all and 96 for beef progeny testing in the field relative to performance testing only. Glaser et al. (1985) quote 150 DM as costs per animal when progeny testing is carried out on contract farms. With 15 progeny per bull the benefit/cost ratio is about 20. The magnitude of the ratios indicate that efficient selection for beef merit in dual purpose breeds can be very profitable.

CONCLUSIONS

It has been shown that for countries where the price of concentrates is relatively high and land for beef cows expensive, dual purpose cattle are economically superior to specialized dairy and beef cattle for supplying milk and beef (Hoffmann et al., 1980). Therefore one may question why comparatively little attention has been devoted to the beef component of milk cattle.

One problem is inherent in the practice of selling calves in many areas at very young ages - one week - when differences in beefing qualities cannot be recognized by the buyer (Anon., 1982). However, there are exceptions. Colleau (1982) reports a genetic correlation of nearly 0.40 between classification at sale of one week old calves and carcass capacity of veal at about 200kg live weight. When calves are sold at later ages, e.g. 2 to 2 1/2 months as is common in Bavarian Fleckvieh, the correlations are more favorable (Schild et al., 1983). It would appear that a selling system where the potential beefing merit of calves can be ascertained should make obvious the need of serious attention to the estimation of the beef merit of AI bulls.

Another reason for the little weight given to improvement of the beef merit is the contention of many researchers that differences in it are of relatively minor importance vis-à-vis improvements in dairy merit. For example Wismans (1984) points out that genetic variance of beef merit is 50 % of the variance of dairy merit and Philipsson (1984) estimates that in Swedish Friesians 70 % of the variance of bull indices is due to the milk sub-index and only 6,8 and 19 % are caused by variation of the sub-indices for meat, fertility and other functional traits, respectively. On the other hand, Glaser et al. (1985) find that up to nearly 50 % of the genetic progress in total genetic merit is contributed by beef improvement and the model calculations in table 5 as well as the figures given by Cunningham and Nioii (1982) also point to rather larger influence of the beef component on total genetic merit.

The discrepancy between these conclusions are partly explained by the inadequacies of marketing which as discussed above reflect only little of differences in beef merit but they are also due to the relative low weight given to carcass conformation and therefore to lean content in the calculations.

Our knowledge of the genetic correlation between dairy and beef merit is clearly wanting and data should be collected.
which permit good estimates. The rather large volume of completely dissected carcasses at meat research institutes frequently lacks pedigree information and is not suitable for such investigations. It is urgent that in future such work should be performed on material which permits genetic analysis.

Further studies on the optimal organization of testing for beef merit where proper attention is given to carcass value are needed. However, improvement of methods and/or organization of marketing which permit recognition of quality differences of dairy breed calves are necessary to ensure proper attention by farmers to the beef component of dual purpose cattle.

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