COMBINING SELECTION FOR CARCASS QUALITY AND MILK TRAITS IN DAIRY CATTLE

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SUMMARY

Alternative selection indices were constructed for breeding for both carcass quality and milk traits in dairy cattle, and their efficiency was studied by comparing predicted genetic responses. Particular interest was on loss of response with indices that ignored partially or totally genetic correlations between traits. Also possibilities of restricting increase in live weight of dairy cows, while still breeding for beef and milk production traits, were studied. Simplified indices gave almost same total response as full multitrait index, but relative responses in beef and milk traits differed between indices. All economically sound indices resulted in increase of carcass weight of dairy cows.

Keywords: carcass traits, beef production, dairy cattle, selection index

INTRODUCTION

In Europe a major part of beef is still produced by dairy cows and as such forms a by-product of milk production. Most countries also acknowledge this in their breeding programs for dairy breeds.

Beef traits used in breeding evaluation of dairy sires vary widely between countries, but lately several European countries have started to use routinely collected progeny carcass data from slaughter houses in breeding evaluation of dairy bulls. However, as use of carcass data is still fairly new, many questions remain as to best way of incorporating carcass traits into existing breeding programs of dairy cattle. Especially carcass weight of cows, that has strong positive correlations with growth traits and milk production but completely opposite economic value due to increased maintenance costs, has aroused interest as to how constrain it while still improving correlated traits.

Objective of this study was to compare efficiencies of alternative selection indices for breeding for both carcass quality and milk traits in dairy cattle. Particular interest was on possible loss of response with simplified indices, that are more likely to be used in practice than complete multivariate indices.

MATERIALS AND METHODS

Traits, their genetic and phenotypic parameters, and discounted economic values are presented in Tables 1 and 2. Genetic and phenotypic parameters for carcass traits were estimated by De

Jong (1997). Genetic and phenotypic parameters for milk production traits were estimated by Van Veldhuizen *et al.* (1991). Genetic and phenotypic correlations between beef and milk traits were adapted from Van Veldhuizen *et al.* (1991), by individually altering parameters until a positive-definite variance/covariance matrix was achieved. Economic values were derived and discounted to represent current Finnish situation, using profit equations described by Bekman and Van Arendonk (1993) and Van der Werf *et al.* (1997), and geneflow method described by Hill (1974). Only sires to breed dams path was taken into account.

Table 1. Studied traits (abbreviation), their discounted economic values (in FIM), and economic values of one genetic standard deviation unit (FIM/unit)

Traits	Units	DEV	σ_G*DEV
Fleshiness bulls (FLb)	EUROP (1-15)	80.96	68.01
Fatness bulls (FAb)	EUROP (1-15)	-98.20	-59.90
Carcass weight bulls (CWb)	kg	7.57	102.57
Fleshiness cows (FLc)	EUROP (1-15)	76.25	34.31
Fatness cows (FAc)	EUROP (1-15)	-59.19	-64.52
Carcass weight cows (CWc)	kg	-4.40	-65.43
Milk yield (MY)	kg	0.02	7.24
Fat yield (FY)	kg	10.49	174.13
Protein yield (PY)	kg	39.02	487.75

Alternative selection indices were constructed to estimate breeding values of young bulls at time they got their first breeding value evaluations based on their daughters' milk production data. Carcass data was assumed available for 100 sons and 10 daughters, and milk production data for 100 daughters at that point. "Beef daughters" and "milk daughters" were assumed to be different animals, so that phenotypic correlations between cow carcass traits and milk production traits were not needed.

Table 2. Heritabilities (on diagonal), phenotypic correlations (below) and genetic correlations (above) of carcass and milk traits

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. FLb	.23	.02	.57	.74	.27	.51	.32	.33	.35
2. FAb	.05	.29	.19	.00	.73	.03	.57	.51	.52
3. CWb	.25	.31	.22	.51	.10	.78	.82	.81	.81
4. FLc				.07	.38	.54	.25	.18	.20
5. FAc				.33	.18	.32	.35	.30	.33
6. CWc				.30	.50	.17	.69	.60	.66
7. MY							.31	.79	.86
8. FY							.86	.37	.88
9. PY							.93	.90	.34

Five alternative types of selection indices were constructed. Base selection index (**I_1**) was a multitrait index, that included all traits in Table 1 in both breeding goal, weighted with their respective discounted economic values, and as index traits. Predicted response in other constructed indices was compared to predicted response in base situation, by efficiency criteria presented in Gibson and Van Arendonk (1996). Constrained index (**I_2**) was alike to base index except for setting desired gain in CWc to zero. Both combination indices had multivariate subindices for beef (including all carcass traits) and milk (including all milk traits), summed together to form one final index. First combination index (**I_3**) consisted of completely separate beef and milk subindices, that had only beef and milk traits in breeding goals respectively, while second combination index (**I_4**) included all traits in breeding goals of both otherwise separate subindices. Univariate index (**I_5**) consisted of single trait subindices for each trait, that were summed to a final index. Finally, milk index (**I_6**) had only milk traits in both breeding goal and as index traits. In all comparisons, selection intensity was assumed one.

RESULTS AND DISCUSSION

Predicted responses from alternative indices are represented in Table 3. Use of base index (**I_1**) resulted in an increase in all traits, changes being unfavourable for fatness of both bulls and cows and carcass weight of cows. This was unavoidable, as assumed correlations between these traits and favourable beef and milk traits were strong and positive. Largest monetary responses were found in protein yield (453.88 FIM), fat yield (154.70 FIM) and carcass weight of bulls (90.88 FIM).

Desired gain constraint set for CWc resulted in considerable loss of predicted total response (Table 3, **I_2**). In view of this, selection for reduced body weight of dairy cows as suggested for example by Yerex *et al.* (1988) does not seem economically feasible, since it is unlikely that better efficiency of small cows will compensate for this large losses in production traits. Moreover, it is hard to set a realistic economic value for CWc, as it is very sensitive to changes in for example feed costs and culling policy (van der Werf *et al.* 1997).

Ignoring some or even all genetic and phenotypic correlations between beef and milk traits hardly affected predicted responses (Table 3, **I_3**, **I_4** and **I_5**). Total responses from both combination indices and univariate index were 99% of predicted response of base index. This was mainly due to dominating effect of protein yield in breeding goal, which was further demonstrated by milk index (**I_6**) that alone gave 96% of predicted total response of base index.

However, even though predicted total responses were almost same for all indices apart from **I_2**, proportional gain coming from beef and milk traits differed somewhat. In **I_1**, **I_3** and **I_5** gain from beef traits was 7-8% of total response, while in **I_4** proportion was slightly lower. **I_6** gave only 3% of total response from beef traits, and **I_2** resulted in a negative response of -8% in beef traits. Reducing economic weight of PY in **I_1** to half of original shifted balance so that over 10% of total response was due to gain in beef traits, even though total response as a whole was not affected (results not shown).

Table 3. Predicted total genetic response (in FIM) and response in individual traits (in units) from alternative selection indices

Trait	I_1	I_2	I_3	I_4	I_5	I_6
FLb	0.3964	-0.0068	0.3780	0.3719	0.3735	0.2797
FAb	0.2268	0.3485	0.2135	0.2808	0.2373	0.3070
CWb	12.0056	3.6199	11.6548	12.0540	11.6669	10.6156
FLc	0.1612	-0.0694	0.1411	0.1609	0.1398	0.0919
FAc	0.2512	0.2841	0.2273	0.3151	0.2474	0.3354
CWc	10.3963	0.0056	10.3235	10.3285	10.1311	9.2518
MY	290.6219	113.6079	285.9162	312.7398	293.6146	293.1885
FY	14.7473	10.1212	14.5181	14.9750	14.6009	14.7830
PY	11.6319	7.4104	11.5143	11.5929	11.5799	11.7597
Total	666.7690	368.0953	657.0475	657.6501	657.5831	639.1039
Efficiency	1.0000	0.5521	0.9854	0.9863	0.9862	0.9585

In breeding value estimation of young dairy bulls data sets used are often large, and multivariate indices can be computationally expensive or even impossible. Based on these results, simplified selection indices that ignore some or even all genetic and phenotypic correlations between carcass quality and milk traits can be used for estimation of breeding values of young dairy bulls without fear of reduced response. However, apart from total predicted response a balance of proportional gain in both beef and milk traits should be aimed for. Also more reliable estimates of genetic correlations between carcass quality and milk production traits are needed in order to verify if they are indeed positive, since they have a major impact on true achieved response in carcass quality traits of dairy cattle.

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