Feasibility of International Genetic Evaluation for Workability Traits

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1. Introduction

Over the last decades there has been a large increase in average herd size in many parts of the world allowing the farmer to spend less time on individual animals. Milkability and temperament are traits influencing the time needed per animal and are therefore of great importance in large dairy operations. Several Interbull member countries do have a national genetic evaluation for milkability and temperament and include these traits in their breeding goal.

The first pilot study for these traits was performed by Bagnato *et al.* (2007) and it was decided to make a second call for data giving more countries the opportunity to participate or send to send updated files. The aims of this study were to estimate correlations between countries for workability traits, post process correlations, predict international breeding values and to correlate milkability proofs to international proofs of SCC and some udder conformation traits.

2. Material and Methods

2.1 Data

Nationally predicted genetic merit calculated for bulls from Australia (AUS), Canada (CAN), Switzerland (CHE), Germany-Austria (DEA), Denmark-Finland-Sweden (DFS), United Kingdom (GBR), Italy (ITA), Japan (JPN), The Netherlands (NLD), New Zealand (NZL), and The United States (USA) and of the breeds Brown Swiss (BSW), Guernsey (GUE), Holstein (HOL), Jersey (JER) and Red Dairy Cattle (RDC) were included in the current study. All populations submitted data for milkability. Majority of populations also submitted data on temperament. In total, 28 breed-country combinations submitted-data for milkability and 23 breed-country combinations for temperament.

Along with the data national evaluation centers sent Genetic Evaluation forms (GE-forms) describing their national genetic evaluation for workability traits. A brief summary of models, heritabilities and trait definitions can be seen in Table 9 and Table 10 for milkability and temperament, respectively.

2.2 Methods

Standard MACE software (Klei, 1998; Klei & Weigel, 1998) was used to obtain across country genetic correlations and international breeding values. The rule of at least 10 daughters in 10 herds was applied. For correlation estimation, records from bulls born from 1970 onwards was used and for breeding value prediction records from bulls born from 1986 (Holstein) or 1981 (other breeds) were used. Male pedigree was traced as far back as possible.

Correlations were post processed following the procure as used for other traits currently evaluated by Interbull. (Interbull, 2008).

3. Results and Discussion

Estimated across country genetic correlations and number of common bulls for milkability and temperament in BSW, HOL, JER and RDC breeds are shown in Tables 1-7. For each of the traits temperament in Brown Swiss and milkability and temperament in Guernsey there were only two participating countries. The estimated correlation between CAN and NLD for temperament in BSW was -0.99. The corresponding values for AUS and CAN in Guernsey were 0.85 and 0.21 for milkability and temperament, respectively.

Table 1. Estimated genetic correlations for *milkability* for Brown Swiss above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	CAN	CHE	DEU	ITA	NLD	USA	av_est	av_post
CAN		0.80	0.63	0.65	0.68	0.67	0.69	0.86
CHE	43		0.95	0.91	0.97	0.74	0.87	0.87
DEU	62	220		0.88	0.97	0.65	0.82	0.90
ITA	46	128	124		0.93	0.91	0.86	0.90
NLD	13	21	28	21		0.79	0.87	0.92
USA	46	87	63	39	11		0.75	0.87

Table 2. Estimated genetic correlations for *milkability* for Holstein above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	CHE	DEU	DFS	GBR	ITA	JPN	NLD	NZL	av_est	av_post
AUS		0.87	0.92	0.92	0.93	0.87	0.92	0.89	0.94	0.93	0.91	0.91
CAN	570		0.96	0.94	0.97	0.79	0.92	0.95	0.95	0.90	0.92	0.92
CHE	133	234		0.99	0.99	0.86	0.97	0.95	0.99	0.93	0.95	0.95
DEU	245	409	223		0.99	0.89	0.97	0.93	0.98	0.90	0.95	0.94
DFS	202	328	192	344		0.88	0.97	0.96	0.99	0.92	0.95	0.96
GBR	400	784	264	415	387		0.86	0.86	0.86	0.80	0.85	0.86
ITA	282	540	210	419	367	502		0.91	0.97	0.91	0.93	0.93
JPN	204	397	135	221	207	299	284		0.96	0.89	0.92	0.92
NLD	397	500	255	571	447	651	513	283		0.93	0.95	0.95
NZL	409	321	109	169	184	214	230	160	362		0.90	0.91

Table 3. Estimated genetic correlations for *temperament* for Holstein above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	CHE	DEU	DFS	GBR	JPN	NLD	NZL	av_est	av_post
AUS		0.64	0.54	0.60	0.73	0.65	0.70	0.70	0.71	0.66	0.66
CAN	482		0.75	0.92	0.87	0.65	0.80	0.89	0.53	0.75	0.77
CHE	133	232		0.77	0.77	0.70	0.75	0.66	0.50	0.68	0.62
DEU	198	280	184		0.92	0.75	0.79	0.87	0.51	0.77	0.69
DFS	202	320	192	286		0.85	0.84	0.88	0.58	0.80	0.72
GBR	400	709	265	318	387		0.80	0.71	0.52	0.70	0.64
JPN	204	379	135	182	207	300		0.81	0.62	0.76	0.68
NLD	386	447	236	411	431	622	268		0.70	0.78	0.70
NZL	409	275	109	137	184	315	160	357		0.58	0.54

Table 4. Estimated genetic correlations for *milkability* for Jersey above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	DFS	NLD	NZL	av_ est	av_ post
AUS		0.66	0.62	0.98	0.86	0.78	0.89
CAN	94		0.71	0.79	0.54	0.68	0.87
DFS	28	25		0.68	0.66	0.67	0.88
NLD	12	6	4		0.84	0.82	0.91
NZL	128	42	35	9		0.72	0.87

Table 5. Estimated genetic correlations for *temperament* for Jersey above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	DFS	NLD	NZL	av_ est	av_ post
AUS		-0.09	0.15	0.42	0.84	0.33	0.65
CAN	84		0.84	-0.82	-0.17	-0.06	0.70
DFS	28	22		-0.71	-0.09	0.05	0.71
NLD	12	6	2		0.67	-0.11	0.73
NZL	128	39	35	8		0.31	0.66

Table 6. Estimated genetic correlations for *milkability* for Red Dairy Cattle above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	DEU	DFS	NZL	av_ est	av_ post
AUS		0.75	0.86	0.89	0.73	0.81	0.89
CAN	30		0.97	0.95	0.96	0.91	0.93
DEU	3	2		1.00	0.92	0.94	0.93
DFS	43	41	9		0.89	0.93	0.92
NZL	27	16	0	29		0.87	0.91

Table 7. Estimated genetic correlations for *temperament* for Red Dairy Cattle above the diagonal and number of common bulls below the diagonal. To the right average estimated (av_est) genetic correlations and average post processed (av_post) correlations per country.

	AUS	CAN	DEU	DFS	NZL	av_est	av_post
AUS		0.68	0.75	0.71	0.87	0.75	0.72
CAN	27		0.12	0.99	0.64	0.61	0.78
DEU	4	1		0.11	0.57	0.39	0.74
DFS	43	41	4		0.72	0.63	0.79
NZL	27	13	0	29		0.70	0.71

Genetic links between populations, as judged by number of common bulls, were very strong in Holstein breed, in which estimated correlations for milkability were in the range of 0.79 to 0.99. As a matter of fact, four countries had an average genetic correlation of 0.95 with the other participating populations. Estimated correlations for temperament in Holtein breed were moderate to high (0.60 to 0.80). Considering the "unharmonized" subjective scoring of temperament, even the estimated correlations for temperament should be considered as very good.

Correlations in other breeds, whenever there was strong links, followed the same pattern as in the Holstein breed. Therefore, it can be assumed that the true correlations would be similar across breeds.

Product moment correlations between international breeding values for milkability and international breeding values for cell count, fore udder attachment, teat length, rear teat placement, udder support and udder depth can be seen in Table 8 on three Brown Swiss country scales as well as three Holstein country scales. Negative correlations were obtained to cell count for both breeds but lower correlations for BSW compared to HOL. Also negative correlations were obtained to teat length here of a similar magnitude for both breeds.

Table 8. Product moment correlations between international milkability proofs and cell count, fore udder attachment, teat length, rear teat placement, udder support, udder depth.

Country	Breed	Cell Count	Fore Udder	Teat Length	Rear Teat Placement	Udder Support	Udder Depth
ITA	BSW	-0.11	0.07	-0.16	0.01	0.00	0.07
DEA	BSW	-0.14	0.10	-0.16	0.01	-0.01	0.02
CHE	BSW	-0.13	0.05	-0.17	-0.04	-0.02	0.02
ITA	HOL	-0.22	0.12	-0.17	0.07	0.08	0.13
DEU*	HOL	0.21	0.13	-0.18	0.08	0.08	0.14
DFS	HOL	-0.22	0.09	-0.18	0.04	0.05	0.13

* Low breeding values are desirable for cell count

4. Conclusion

High values of number of common bulls and high values of estimated genetic correlations provide all the pre-requisites of the routine international genetic evaluation for both workability traits for Holstein. Also for other breeds correlations look good for milkability, but variable for temperament for BSW and JER.

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References

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Table 9. Country (CNT), national evaluation model, data inclusion, breeds, heritability (h^2) and trait definition for milkability traits.

CNT	Model	Data inclusion from	Breeds	h^2	Trait
AUS	ST-AM	1980	HOL, JER, RDC, GUE	0.25	Milkability scored on an A (fast) to E (slow) scale
CAN	ST-AM	1982	BSW,RDC, HOL,GUE, JER	0.21	Milking speed. 1 (very slow) to 5 (very fast)
CHE (BSW)	ST-AM	1994	BSW	0.144	Milking speed. 1 (very slow) to 6 (very fast)
CHE (HOL)	MT-AM	1992	HOL	0.1837	Milking speed. Very slow to very fast on a 5-point scale.
DEA	MT-TD-AM	1990	BSW	0.35	Milking speed Kg/min / subj. score 1 (very slow) to 6 (very fast)
DEU	MT-AM	1990	HOL, RDC	0.198	Milk flow rate kg/min and subj. score
DFS	ST-AM	1988	RDC, HOL	0.25	Milking speed. Scale 1-9.
DFS	ST-AM	1988	JER	0.19	Milking speed. Scale 1-9.
GBR	MT-AM	1983	HOL	0.11	Ease of milking. Scale 1-9.
ITA (BSW)	ST-TD-AM	1981	BSW	0.20	Milk flow Kg/min measured with electronically flow meters
ITA (HOL)	ST-AM	1994	HOL	0.06	Subj. score. 0 (normal), 1 (slow milking)
JPN	ST-SM	1987	HOL	0.11	Milking speed. Subj. score 3-point scale
NLD	MT-AM	1994(NLD) 1991 (FLA)	HOL, BSW, JER	0.21	Milking Speed. Subj. score 1-9 scale (FLA 1-5 scale until June 2004)
NZL	ST-AM	1987	RDC,HOL, BSW, JER, GUE	0.14	Milking speed. 1 (slow) to 9 (fast)
USA	AM	2004	BSW	0.22	Milking speed, rate on a scale of 1 (slow) to 8 (fast)

Table 10. Country (CNT), national evaluation model, data inclusion, breeds, heritability (h^2) and trait definition for milking temperament.

CNT	Model	Data inclusion from	Breeds	h^2	Trait
AUS	ST-AM	1980	HOL, JER, RDC, GUE	0.16	Temperament scored on an A to E scale
CAN	ST-AM	1993	BSW, RDC, HOL, GUE, JER	0.08	Milking temperament 1 (very nervous) to 5 (very calm)
CHE	MT-AM	1992	HOL	0.1393	Nervous, normal, quiet. 3-point scale
DEU	MT-AM	1990	HOL, RDC	0.07	Milking temperament. Scale 1-5.
DFS	ST-AM	1988	JER	0.05	Temperament. Scale 1-9.
DFS	ST-AM	1988	HOL, RDC	0.15	Temperament. Scale 1-9.
GBR	MT-AM	1983	HOL	0.10	Temperament. Scale 1-9.
JPN	ST-SM	1987	HOL	0.08	Temperament. 2-point scale
NLD	MT-AM	1994(NLD), 1991 (FLA)	HOL, BSW, JER	0.10	Milking temperament. Subj. score 1-9 (FLA 1-5 scale until June 2004)
NZL	ST-AM	1987	RDC, HOL, BSW, JER, GUE	0.21	Temperament in the dairy while being handled and milked. 1 (vicious) to 9 (placid)