Acta Agriculturae Scandinavica, Section A — Animal Science

ISSN: 0906-4702 (Print) 1651-1972 (Online) Journal homepage: http://www.tandfonline.com/loi/saga20

Herd characteristics influence farmers' preferences for trait improvements in Danish Red and Danish Jersey cows

M. Slagboom, M. Kargo, D. Edwards, A. C. Sørensen, J. R. Thomasen & L. Hjortø

ACTA AGRICULTURAE SCANDINAVICA, SECTION A — ANIMAL SCIENCE, 2017
http://dx.doi.org/10.1080/09064702.2016.1277550

Taylor & Francis
Taylor & Francis Group

SHORT COMMUNICATION

Herd characteristics influence farmers' preferences for trait improvements in Danish Red and Danish Jersey cows

M. Slagboom[a], M. Kargo[a,b], D. Edwards[a], A. C. Sørensen[a], J. R. Thomasen[c] and L. Hjortø[a,b]

[a]Department of Molecular Biology and Genetics, Center for Quantitative Genetics and Genomics, Aarhus University, Tjele, Denmark; [b]SEGES Cattle, Aarhus N, Denmark; [c]VikingGenetics, Assentoft, Denmark

ABSTRACT
The aim of this study was to characterize preferences of farmers for breeding goal traits with Danish Red (DR) or Danish Jersey (DJ) cows. A breed-specific survey was established to characterize farmers' preferences for improvements in 10 traits, by means of pairwise rankings using the online software 1000Minds. These pairwise rankings were based on equal economic worth of trait improvements. The DR survey was filled in by 87 farmers and the DJ survey by 76 farmers. Both DR and DJ farmers gave the highest preference to improvements in mastitis, and the lowest to calving difficulty. By means of a cluster analysis, three distinct clusters of farmers were identified per breed. Comparisons of herd characteristics between clusters suggest that farmers choose to improve traits that are problematic in their herds. This study shows that heterogeneity exists in farmers' preferences for trait improvements and that herd characteristics influence these preferences in DR and DJ.

ARTICLE HISTORY
Received 9 September 2016
Revised 8 November 2016
Accepted 21 December 2016

KEYWORDS
Breeding goal; cluster analysis; conventional; dairy cow; organic

Introduction

In the development of breeding goals, it is important to take into account the objectives of stakeholders (Nielsen et al., 2014). In the case of dairy breeding, this means that farmers' perspectives need to be taken into account. Previous studies have shown that heterogeneity exists in farmers' preferences for improvements in breeding goal traits for Holstein cattle and that certain clusters or 'types' of farmers can be identified (Martin-Collado et al., 2015; Slagboom et al., 2016). Such heterogeneity might lead to the need for diversification of the breeding goal (Nielsen & Amer, 2007). Trait improvement preferences have been shown to be influenced by production system (whether or not the farm is organic) and certain herd characteristics in Danish Holstein (Slagboom et al., 2016). Ahlman et al. (2014) showed that production level, gender and age of the farmer, and production system affect trait improvement preferences for some traits. The breed used on the farm might also be important, since different breeds have different characteristics. In Denmark, in addition to Holstein, Danish Red (DR) and Danish Jersey (DJ) cattle are used in both conventional and organic dairy production. The DR and DJ populations together make up about 20% of all dairy cows in Denmark (Team Avlsværdivurdering: Årsstatistik Avl, 2014/2015). Although smaller in numbers, these breeds play an important role in the Danish dairy sector. The DJ is a smaller cow, which is very efficient at milk production when body size is taken into account. DR have a higher potential for meat production, and are thus more suitable for dual-purpose production. So far, no study has been published on the preferences of farmers with DR or DJ cows. The aim of this study is to characterize preferences of Danish dairy farmers with DR or DJ cows. The specific aims of this study are (1) to investigate the presence of heterogeneity in farmers' preferences by means of a cluster analysis and (2) associate these clusters with herd characteristics and production system. The hypotheses are that heterogeneity exist in farmers' preferences and that herd characteristics and production system differ between clusters.

Material and methods

A breed-specific survey was established to characterize preferences of farmers for improvements in 10 traits, by means of pairwise rankings. The preference survey used the online software 1000Minds (1000Minds Ltd., Dunedin, New Zealand), which applies the PAPRIKA method to minimize the number of questions (Hansen & Ombler, 2009). The farmers choose from two alternatives, formulated in such a way that either the first trait is improved and the second remains at the same level as in the farmer's herd today, or vice versa. Farmers could also choose for the option 'they are equal'. The improvements of the two traits represented equal

CONTACT M. Slagboom margotslagboom@mbg.au.dk

Table 1. Breeding goal traits included in the preference survey for farmers with Danish Red (DR) or Danish Jersey (DJ) cows and improvements corresponding to 100 DKK.

Trait	Description	Improvement presented in the survey		
		DR	DJ	
Cow fertility	Pregnancy rate in cows	+10	+8	Pregnancies per 100 inseminations
Heifer fertility	Pregnancy rate in heifers	+11	+13	Pregnancies per 100 inseminations
Calving difficulty	A difficult calving	−8.6	−8.5	Cases per 100 cow-years[a]
Calf mortality	Death within 15 months after birth	−64	−23	Dead heifers and heifer calves per 100 cow-years[a]
Cow mortality	Mortality and involuntary culling	−1.8	−1.7	Cases per 100 cow-years[a]
Hoof and leg diseases	Hoof and leg diseases	−13.9	−17.9	Cases per 100 cow-years[a]
Mastitis	Clinical mastitis	−5.0	−5.1	Cases per 100 cow-years[a]
Other diseases	Reproductive, digestive and metabolic diseases	−10.9	−8.6	Cases per 100 cow-years[a]
Milk production	305 day ECM[b] yield	+35	+33	kg ECM[b] per 305 days of lactation
Feed efficiency	ECM[b] yield per feed unit	+0.01	+0.01	kg ECM[b] per feed unit

[a]The number of cow-years equals the number of feeding days per year (for all the cows in a herd) divided by 365.
[b]Energy corrected milk. Test-day yield of ECM (kg) was calculated as [kg of milk × (383 × fat % + 242 × protein % + 780.8)]/3140.

monetary value, based on economic weights derived by means of the methods described in Østergaard et al. (2016) (Table 1). Herd characteristics were gathered by means of a general questionnaire, which was part of the preference survey, and extraction of herd data from the cattle database (Bundgaard & Høj, 2000). Recorded herd characteristics include herd size, housing system, yearly yields, disease treatments, mortality rate, fertility, and carcass features, amongst others (the full list can be found in Slagboom et al. (2016)). The survey was sent out to almost all dairy farmers in Denmark (organic $n = 357$, conventional $n \approx 3000$), but only the results from farmers with DR or DJ cows are included in this paper. The most preferred trait had rank 1 and the least preferred trait had rank 10. Mean differences in trait ranks were analysed by means of a Friedman test (Friedman, 1937) for DR and DJ answers separately, followed by a cluster analysis. All herd characteristics were tested for homogeneity across clusters using a Kruskal–Wallis test. A significant result ($P < .05$) of the Kruskal–Wallis test for a characteristic meant that at least one of the cluster means differed from the others. In addition, differences in mean trait ranks and herd characteristics between organic and conventional farmers were analysed with a Kruskal–Wallis test per breed. For a full description of the used methods, see Slagboom et al. (2016).

Results and discussion

The response rate for the preference survey was 48% for organic farmers and 13% for conventional farmers for the three major dairy breeds in Denmark. In this study, we used the answers from farmers that inseminate some or all of their cows with DR or DJ semen.

Danish Red

The DR survey was filled in by 87 Danish dairy farmers; 29 organic and 58 conventional farmers. These farmers gave the highest preference to improvements in mastitis (average rank of 4.38 ± 0.29 [mean ± SE]), followed by improvements in milk production. The lowest preference was given to calving difficulty (7.49 ± 0.26). Significant differences were found between a number of trait ranks (Figure 1), although the level of variability in preferences meant that at the whole surveyed population level, significant differences could not be established for the majority of traits. By means of a cluster analysis, farmers with DR cows were divided into three different clusters, which were named according to the trait improvements that were the most preferred per cluster: Robustness, Production and Health, and Fertility and Production (Figure 2). All mean trait ranks differed between clusters ($P < .05$) according to a Kruskal–Wallis test, implying that at least one of the clusters had a different mean. This means that farmers in these different clusters clearly prefer improvements in different traits. In other words, heterogeneity exists in preferences of farmers using DR semen.

We found herd characteristics that significantly ($P < .05$) differed between clusters (Table 2). The most substantial differences were found between the cluster 'Robustness' and the cluster 'Fertility and Production'. Farmers in the first cluster gave milk production the lowest rank of all three clusters, whereas farmers in the last cluster gave milk production the highest rank of all. Interestingly, herds in the first cluster had the highest average yield (energy corrected milk, yearly milk, fat, and protein yield) and herds in the last cluster the lowest average yield, suggesting that farmers want to improve yield in their herd because it is lower than on average for all farmers. The last cluster also had the highest percentage of organic farmers amongst the respondents (50%), which suggests that organic farmers are more inclined to prefer improvements in milk production than conventional farmers. This corroborates the findings of Slagboom et al. (2016) for Holstein farmers in Denmark. The increased preference for

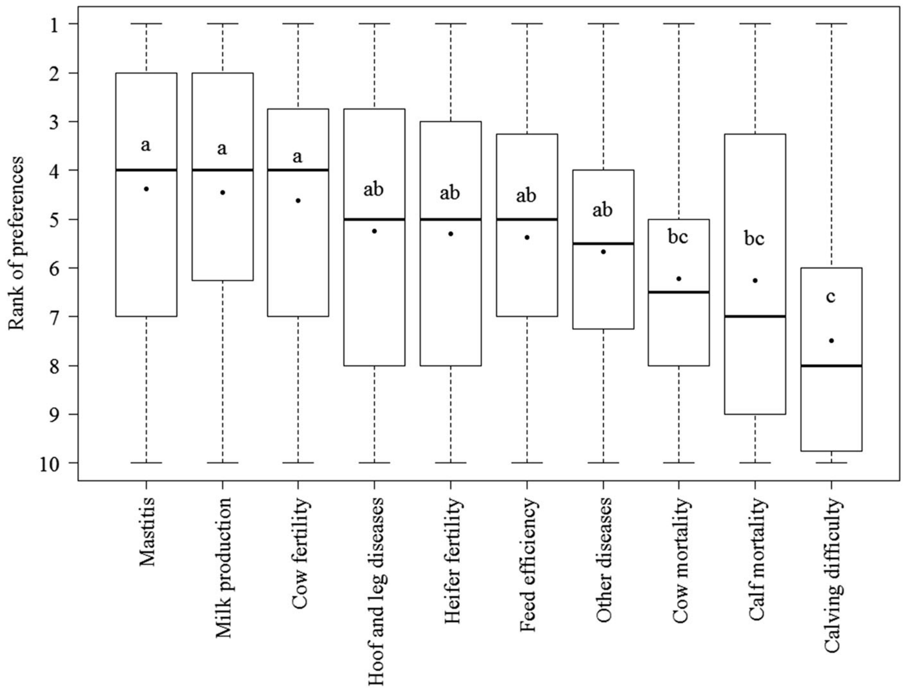

Figure 1. Boxplot of trait ranks for the 10 traits evaluated by the survey for farmers with Danish Red cows. Means with different letters differ ($P < 0.05$) according to a *post hoc* test due to Nemenyi.

improving milk production might be caused by the higher price of organic milk, and the lower yield in organic herds compared to conventional herds ($P < .001$; data not shown). It may be noted that organic farmers had significantly less hoof and leg, metabolic, reproduction, and udder disorders, and dead cows in their herd than conventional farmers (P-values range between <.001 and .02; data not shown). This could mean that improving health traits is not regarded as important because it is a lesser problem in organic herds. This gives room for increasing milk yield, and therefore increasing farmers' incomes. This suggests that the preference for improving milk production is mostly influenced by whether or not the farm is organic and the current milk yield in the herd, based on the data collected in this study.

Another herd characteristic that significantly differed between the cluster 'Robustness' and the cluster 'Fertility and Production' is the percentage of farmers that use systematic crossbreeding with other dairy breeds. The cluster 'Robustness', with the highest average yield, had the highest percentage of crossbreeding. Thus, some of the farmers answering in this cluster may be farmers having Holstein, Jersey, or crossbred cows, but using DR sires in their crossbreeding program. In this cluster, 53% of the farmers used insemination with Holstein, whereas in the other two clusters around 30% of the farmers indicated to use Holstein semen (non-significant difference, $P = .18$). This might explain why the average milk yield is higher in the cluster 'Robustness', since on average Holsteins have a higher milk yield than DR. We also found that farmers in the cluster 'Production and Health' had a higher preference for improving mastitis than farmers in the cluster 'Fertility and Production'. The herds in the cluster 'Production and Health' also had the highest average prevalence of udder disorders, together with herds in the cluster 'Robustness', although the difference between clusters was not significant ($P = .08$). To conclude, a link can be found between farmers' preferences and certain herd characteristics, indicating that farmers using DR semen want to improve traits that are possibly problematic in the herd.

Danish Jersey

The DJ survey was filled in by 76 farmers; 27 organic and 49 conventional farmers. Farmers with DJ cows ranked mastitis the highest (4.29 ± 0.33) and calving difficulty the lowest (7.85 ± 0.31). Only the rank of calving difficulty significantly differed from the other trait ranks ($P < .05$). This might be because of the smaller number of respondents for the DJ survey. The DJ farmers were also divided into three clusters and named according to the trait improvements that were the most preferred per cluster (Figure 3). All mean trait ranks differed between clusters ($P < .05$) according to a Kruskal–Wallis test, except for the mean ranks of calving difficulty and mastitis.

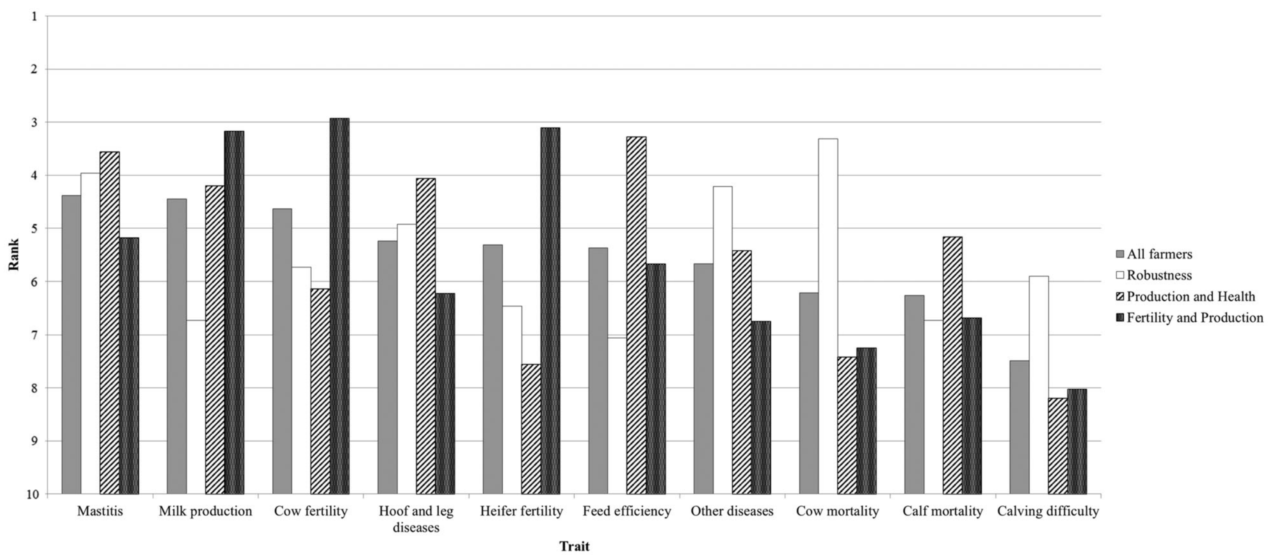

Figure 2. Mean trait ranks for all farmers who answered the survey for Danish Red cows, and per cluster of these farmers.

The percentage of dead cows and the prevalence of udder disorders differed significantly between clusters (Table 3). Farmers in the cluster 'Fertility and Production' ranked reductions in cow mortality very low and their herds had the lowest percentage of dead cows compared to the herds in the other two clusters. On the other hand, farmers in the cluster 'Survival' ranked cow mortality very high and their herds had the highest percentage of dead cows. This suggests that farmers want to improve cow mortality if it is a larger problem in their herd than on average. For Holstein farmers, a clear link between the rank of cow mortality and the percentage of dead cows was also found (Slagboom et al., 2016). In addition, the cluster 'Survival' had the highest prevalence of udder diseases, and these farmers ranked mastitis higher than the other clusters, but the difference in the rank of mastitis between clusters was not significant ($P = .53$). Fewer significant differences were found between clusters of DJ farmers than between clusters of DR farmers, and this might be due to the smaller number of respondents for the DJ survey. However, the clear link that was found between the percentage of dead cows in a herd and the rank of cow mortality, together with the possible rank of mastitis and the prevalence of udder disorders, indicates that farmers with DJ cows also want to improve traits that might be problematic in their herds.

Table 2. Average herd characteristics for all farmers who answered the survey for Danish Red cows, and per cluster of these farmers. Only herd characteristics with a difference between clusters ($P < .10$) are shown.

		Cluster			
	All farmers	Robustness	Production and Health	Fertility and Production	*P*-value[1]
Number of farmers	87	24	25	38	
Herd characteristics					
Crossbreeding[2]	16.0 ± 4.3	$33.3^{a} \pm 11.4$	$16.7^{ab} \pm 7.8$	$6.1^{b} \pm 4.2$	.04
ECM[3]	9167 ± 160	$9723^{a} \pm 197$	$9322^{ab} \pm 328$	$8733^{b} \pm 238$	.01
Herd size[4]	137 ± 9	$153^{a} \pm 23$	$156^{a} \pm 14$	$113^{a} \pm 11$	.05
Organic[5]	33.3 ± 5.1	$16.7^{a} \pm 7.8$	$24.0^{ab} \pm 8.7$	$50.0^{b} \pm 8.2$	.01
Udder disorders[6]	0.23 ± 0.02	$0.27^{a} \pm 0.04$	$0.25^{a} \pm 0.03$	$0.19^{a} \pm 0.03$	.08
Yearly fat yield[7]	391 ± 6	$404^{a} \pm 12$	$402^{a} \pm 12$	$375^{a} \pm 9$	.04
Yearly milk yield[7]	9562 ± 158	$9885^{a} \pm 293$	$9864^{a} \pm 305$	$9142^{a} \pm 226$	.04
Yearly protein yield[7]	323 ± 6	$335^{a} \pm 10$	$334^{ab} \pm 11$	$307^{b} \pm 8$	.03

[a,b]Means within a row with different superscripts differ ($P < .05$) according to Dunn's test for multiple comparisons. Due to an adjustment of *P*-values to correct for the Family-wise error rate, it may occur that pairwise differences cannot be found by Dunn's test, even though the Kruskal–Wallis test shows that at least one of the cluster means is different.
[1]Result of Kruskal–Wallis test with null-hypothesis 'all cluster means are equal'.
[2]The percentage of farmers that answered that they used systematic crossbreeding with dairy breeds in the general questionnaire.
[3]Energy corrected milk, filled in by farmers in the general questionnaire. Test-day yield of ECM (kg) was calculated as [kg of milk × (383 × fat % + 242 × protein % + 780.8)]/3140.
[4]In number of cow-years and filled in by farmers about their own herd in the general questionnaire.
[5]Percentage of respondents that filled in the survey for organic farmers.
[6]Average number of cases per cow-year, extracted from the cattle database.
[7]In kg per year, measured with milk recording system and extracted from the cattle database.

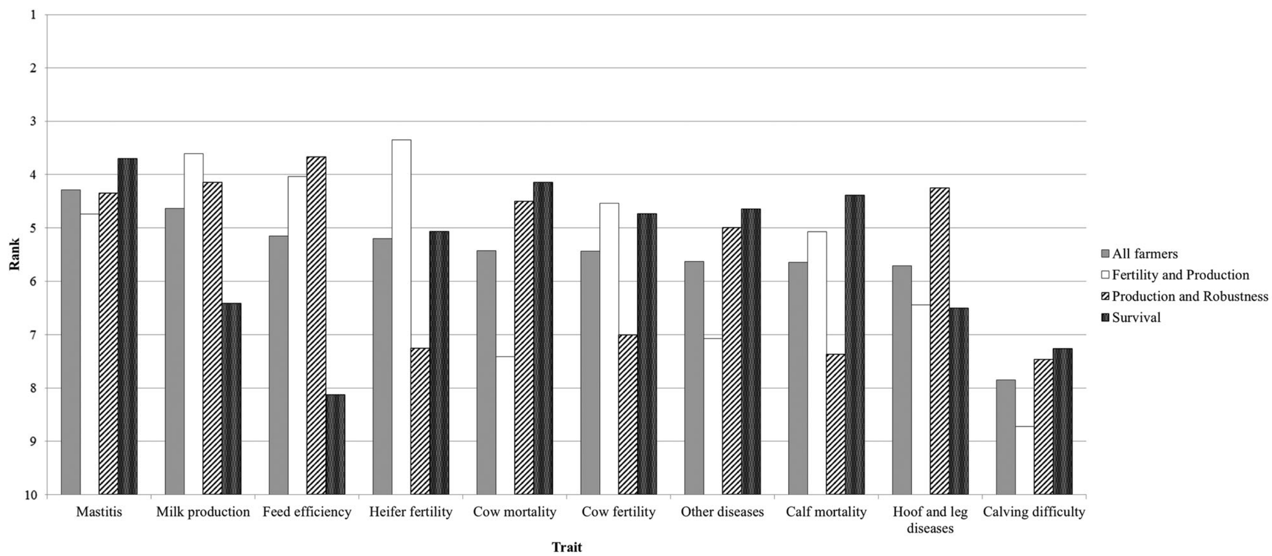

Figure 3. Mean trait ranks for all farmers who answered the survey for Danish Jersey cows, and per cluster of these farmers.

Table 3. Average herd characteristics for all farmers who answered the survey for Danish Jersey cows, and per cluster of these farmers. Only herd characteristics with a difference between clusters ($P < .10$) are shown.

		Cluster			
	All farmers	Fertility and Production	Production and Robustness	Survival	*P*-value[1]
Number of farmers	76	27	26	23	
Herd characteristics					
Dead cows[2]	3.77 ± 0.62	$1.67^{a} \pm 0.78$	$4.40^{a} \pm 1.01$	$5.50^{a} \pm 1.35$	.04
Udder disorders[3]	0.26 ± 0.03	$0.18^{a} \pm 0.04$	$0.27^{ab} \pm 0.04$	$0.33^{b} \pm 0.05$	.03

[a,b]Means within a row with different superscripts differ ($P < .05$) according to Dunn's test for multiple comparisons. Due to an adjustment of *P*-values to correct for the Family-wise error rate, it may occur that pairwise differences cannot be found by Dunn's test, even though the Kruskal–Wallis test shows that at least one of the cluster means is different.
[1]Result of Kruskal–Wallis test with null-hypothesis 'all cluster means are equal'.
[2]Percentage of dead cows on average per herd, extracted from the cattle database.
[3]Average number of cases per cow-year, extracted from the cattle database.

Used methods

The use of predefined improvements in traits might create some bias and increase variability in the results when farmers were forced to choose. However, to limit this bias, farmers could choose for the option 'these improvements are equal'. The improvements presented in the survey were calculated from economic weights simulated for an organic system in Denmark, and were all equal in monetary terms (100 DKK) to minimize bias.

Conclusion

This study shows that heterogeneity exists in farmers' preferences for trait improvements for DR and DJ cows. For both breeds, the results suggest that farmers choose to improve traits that are more problematic in their herds. The results from this study give a strong basis for setting up customized indices at herd level or breeding goals for the different farmer clusters at population level, which might increase the uptake of genetic improvement tools. For setting up different breeding goals at population level, it is important to simulate long-term effects on genetic gain in all traits before using it in practice.

Acknowledgements

The project SOBcows is part of the Organic RDD 2 program, which is coordinated by the International Centre for Research in Organic Food Systems (ICROFS). It has received grants from the Green Growth and Development program (GUDP) under the Danish Ministry of Food, Agriculture and Fisheries.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Ahlman, T., Ljung, M., Rydhmer, L., Röcklinsberg, H., Strandberg, E. & Wallenbeck, A. (2014) Differences in preferences for breeding traits between organic and conventional dairy producers in Sweden. *Livestock Science*, 162, 5–14.

Bundgaard, E. & Høj, S. (2000) *Direct access to the cattle database with livestock registration*. Annual Report 1999. Aarhus, Denmark: National Committee on Danish Cattle Husbandry.

Friedman, M. (1937) The use of ranks to avoid the assumption of normality implicit in the analysis of variance. *Journal of the American Statistical Association*, 32(200), 675–701.

Hansen, P. & Ombler, F. (2009) A new method for scoring additive multi-attribute value models using pairwise rankings of alternatives. *Journal of Multi-Criteria Decision Analysis*, 15(3–4), 87–107.

Martin-Collado, D., Byrne, T. J., Amer, P. R., Santos, B. F. S., Axford, M. & Pryce, J. E. (2015) Analyzing the heterogeneity of farmers' preferences for improvements in dairy cow traits using farmer typologies. *Journal of Dairy Science*, 98 (6), 4148–4161.

Nielsen, H. M. & Amer, P. R. (2007) An approach to derive economic weights in breeding objectives using partial profile choice experiments. *Animal*, 1(9), 1254–1262.

Nielsen, H. M., Amer, P. R. & Byrne, T. J. (2014) Approaches to formulating practical breeding objectives for animal production systems. *Acta Agriculturae Scandinavica, Section A – Animal Science*, 64(1), 2–12.

Østergaard, S., Ettema, J. F., Hjortø, L., Pedersen, J., Lassen, J. & Kargo, M. (2016) Avoiding double counting when deriving economic values through stochastic dairy herd simulation. *Livestock Science*, 187, 114–124.

Slagboom, M., Kargo, M., Edwards, D., Sørensen, A. C., Thomasen, J. R. & Hjortø, L. (2016) Organic dairy farmers put more emphasis on production traits than conventional farmers. *Journal of Dairy Science*, 99(12), 9845–9856.

Team Avlsværdivurdering: Årsstatistik Avl (2014/2015). SEGES Kvæg. Accessed 16 May 2016, available at: https://www.landbrugsinfo.dk/Kvaeg/Avl/Avlsstatistik/Sider/aarsstat_2015.pdf