Survey on the recording and use of functional traits in dairy management and breeding

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Abstract

An important component in sustainability of dairy production is the functionality of the cows. With the substantial progress in the production traits achieved in dairy breeding, health and fertility have become important determinants of profitable milk production. Breeding goals and programs are reflecting this worldwide shift towards functionality. Standardization initiatives in this field are needed, but challenging with regard to trait definitions, recording practices and data analyses. Efficient work of the ICAR working group for recording, evaluation and genetic improvement of functional traits requires intense international and interdisciplinary communication and collaboration. An overview over past, current and future activities of different countries to improve functionality of the dairy cow is supposed to indicate the major tasks of the WG.

Besides indicator traits like somatic cell score for mastitis, direct measures of health and disease will provide valuable information for genetic evaluations. Further traits may be identified and used as tools to improve the functionality of the dairy cow. Guidelines for such new traits have to account for the different and novel sources of information and the parties involved in data recording. Furthermore, technical developments need to be regularly reviewed for options to facilitate collection of for example health data in a broad and reliable manner. A network of experts is required to support the Functional Traits Working Group in compiling and updating the guidelines and identifying the needs for exchange of information and experiences and this way meet the demands of future dairy management and breeding. Approaches to collect and analyze information on functional traits in dairy cattle will be presented and discussed in the context of international needs and expectations, providing an outline for the future activities of the Functional Traits Working Group.

Keywords: survey, functionality, health data recording, genetic evaluation for functional traits

Introduction

Over the years, focusses of dairy breeding programs have changed with a worldwide shift towards functionality. Today, functional traits are weighted higher in the total merit indices than production traits in many countries (Pedersen *et al.*, 2002; Reents & Rensing, 2009). Because of the high performance level achieved in dairy breeding, milk production is challenging the whole body and physiology of a modern dairy cow implying the need for a correspondingly strong constitution. Functional cows may be considered as the key to sustainability, long-term efficiency and competitiveness of milk production. In this context, functional traits can be defined as traits which have no direct economic value, but are of considerable economic importance because of their impact on the production traits and production conditions. Given this rather general definition and the large variety of production conditions under which cows are supposed to be functional, interpretations of functionality and functional traits differ between countries and populations within countries. Clear documentations are largely missing, interfering with international harmonization of recording and use of functional traits.

The purpose of the ICAR working group for functional traits is, according to their terms of reference, to supply member organizations of ICAR with recommendations (standards and guidelines) on recording schemes, evaluation procedures and genetic improvement schemes for functional traits. Although there is much less discussion about functional traits in beef than in dairy cattle, functionality aspects with relevant impact on beef production do also exist and are considered within the scope of the Functional Traits Working Group. Therefore, information on the status quo and prospects of functionality improvement activities in the various countries was broadly collected to be presented to an international audience and provide the basis for demand-oriented work of the Functional Traits Working Group.

Material and methods

Data were collected by a survey that was distributed by email in February 2012 using the mailing list of ICAR members provided by ICAR. Clear structure and wording of the survey, multiple predefined answering options plus room for free text input were chosen to maximize the return of questionnaires. The intention was to keep the balance between time efforts for answering and collection of meaningful data suitable as planning basis for future WG work.

The 20 questions were organized into four blocks entitled as follows:

I. General role of functional traits (3 questions),

II. Direct health traits, with subheadings General approach of health data collection (5 questions), and Current status of health data analyses (5 questions),

III. Other functional traits (2 questions), and

IV. Future perspective of functional traits (5 questions).

Answering options referred to seven groups of functional traits: calving traits, fertility traits, longevity, feet and legs, indirect health traits, i.e. health traits based on indirect measures of disease (like somatic cells for mastitis), direct health traits, i.e. health traits based on direct disease information (like veterinary diagnoses), and others (individual specification).

The completed questionnaires were returned by email or fax, and all answers were compiled using Microsoft EXCEL. Descriptive statistical analyses were then performed using the procedures FREQ and MEANS of the Statistical Analysis System (SAS), version 9.2

Results and discussion

Responses were received from 27 countries, including two countries notifying of absence of any functionality improvement programs (no survey sheets filled in). According to the list of ICAR member organizations (ICAR, 2012) the total number of represented countries is 52, so the response rate to the survey was > 50%. Most of the surveys were completed for dairy (N=12) or dairy and beef populations (N=12). In the later caser, different roles of certain functional traits in dairy and beef cattle were mostly reflected by individual comments on respective items of the survey. Only two countries had submitted separate surveys for dairy and beef, so results will be generally presented by country and not by breed type (dairy, beef) within country.

General information on genetic evaluations (GE) for functional traits was received from 23 countries, whereas numbers of functional traits under GE were specified by only 15 countries for dairy (range 0-43) and 10 countries for beef (range 0-25). In > 70% of the countries, routine GE was established for calving traits, fertility traits, longevity, feet and legs and indirect health traits, with an implementation rate of genomic evaluations of about 50%. Direct health traits were identified as the group of functional traits with most intense research and development activities (GE in early or advanced project status in 48% of the countries) and few routines yet (30% GE with 29% implementation rate of genomic evaluations). This finding was in agreement with the recent international increase of studies and publications on health monitoring (e.g. Østeras *et al.*, 2007; Koeck *et al.*, 2011; Egger-Danner *et al.*, 2012).

Table 1. Status of genetic and genomic evaluations for the different groups of functional traits in 23 countries.

Group of functional traits	EBV P1 (gEBV N-P-R)	EBV P2 (gEBV N-P-R)	EBV R (gEBV N-P-R)
Calving traits	2 (2 - 0 - 0)	3 (2 - 1 - 0)	18 (5 - 4 - 9)
Fertility traits	2 (2 - 0 - 0)	1 (1 - 0 - 0)	20 (5 - 6 - 9)
Longevity	2 (2 - 0 - 0)	4 (3 - 1 - 0)	17 (5 - 4 - 8)
Feet and legs	2 (2 - 0 - 0)	3 (2 - 1 - 0)	17 (2 - 7 - 8)
Indirect health traits	0 (0 - 0 - 0)	2 (1 - 1 - 0)	20 (7 - 4 - 9)
Direct health traits	10 (10 - 0 - 0)	1 (0 - 1 - 0)	7 (1 - 4 - 2)
Others[1]	0 (0 - 0 - 0)	0 (0 - 0 - 0)	5 (1 - 0 - 4)

[1] milkability, temperament, body condition score, feed intake

EBV = conventional breeding values (genetic evaluation, GE); P1 = early project status (possible recording and GE consideration in the future); P2 = advanced project status (definitive recording and GE consideration in the future); R = routine (current recording and GE consideration)

gEBV = genomic breeding values; N = no gEBV; P = project status; R = routine

Recording and current status of analyses of direct health data was specified by 24 countries, indicating that at least vague plans for future work with direct health traits existed in almost 90%

of survey respondents. Health data collection and analyses were in the planning phase in 11 countries, in the starting phase (R&D project with few herds) or intermediate phase (extended data collection and analyses, but no genetic evaluation routines yet) in 8 countries, and in routine (extended / national data collection and analyses with established genetic evaluation) in 5 countries.

Detailed information on health data collection was missing for 5 countries in the (early) planning phase. In the remaining 19 countries, health monitoring systems were mostly based on complex infrastructures: Less than one third of the countries worked with single sources of data, single groups of people recording and sending the data, and single recording methods. The distribution of data sources revealed equal quantitative importance of veterinary treatments, veterinary diagnoses and laboratory data (N=12) and a relevant role of additional on-farm recording, i.e. further health-relevant observations (N=9). No country used veterinary treatment data as the only source of direct health data. The benefits of broadening health data collection and using more than a single source of data have been previously reported from Scandinavia (Østeras *et al.*, 2007).

Table 2. Sources and contents of direct health data used in countries with already implemented or projected health monitoring systems (N=19).

No. of data sources	Veterinary treatments[1]	Veterinary diagnoses[2]	Laboratory data[3]	Health-relevant observations[4]	No. of countries	
1	+	-	-	-	0	5 (26%)
	-	+	-	-	1	
	-	-	+	-	3	
	-	-	-	+	1	
2	+	+	-	-	2	6 (32%)
	+	-	+	-	2	
	+	-	-	+	0	
	-	+	+	-	0	
	-	+	-	+	1	
	-	-	+	+	1	
3	+	+	+	-	2	4 (21%)
	+	+	-	+	2	
	+	-	+	+	0	
	-	+	+	+	0	
4	+	+	+	+	4	4 (21%)

[1] reasons for use of pharmaceuticals; [2] disease diagnoses independent of whether or not pharmaceuticals were used for treatment; [3] data from laboratories and results of refined diagnostics; [4] additional on-farm recording of findings indicative of disease

There were clearly defined responsibilities for recording the health data on farm and sending them to a central database (Tab. 3). Recording was in more than twice as many countries performed by farmers and veterinarians (N=10) than by staff of performance recording agencies and farmers (N=4) or veterinarians (N=4). Data were mostly sent by veterinarians and staff of

performance recording agencies (N=6), farmers and veterinarians (N=5), and farmers and staff of performance recording agencies (N=5).

The use of recording methods was clearly driven by feasibility on farm: Paper sheets (N=16) and herd management software (N=14) were most frequently used, often in combination (N=12). Veterinary software (N=8) and other software or web-based tools (N=7) were almost exclusively used in combination with other recording methods. Efforts which may be needed to get and keep groups of professionals involved have been recently described for the situation in Austria (Egger-Danner *et al.*, 2012).

Table 3. People involved in the collection of direct health data in countries with already implemented or projected health monitoring systems (N=19).

Group of people	Recording on farm	Sending to a central database
Farmer	14	10
Veterinarian	13	9
Staff of performance recording agencies	7	11
Experts (laboratories, claw trimmers, nutritionists, ...)	6	5
Others (breeders' association)	1	0

The number of health traits on which information was collected ranged widely from 1 to > 900, and only 8 countries classified their specificity of health data collection as "few simple traits". The frequently specific and broad data collection was in accordance with the main intentions of health data analyses: Management help for farmers (N=18) and genetic improvement (N=12) both require detailed rather than simplified information. Optimized service and service follow-up (N=8) were by-products of management-oriented analyses. Other intensions of health data analyses included administration reports and research (N=6). Based on a 30-years-experience in health recording, Østeras *et al.* (2007) suggested working with 60 to 70 diagnoses to meet the needs of the dairy industry. Particularly countries with multidisciplinary health monitoring systems may benefit from recording more than a few simple diagnoses or health-relevant observations, and a broader spectrum of health traits could ensure long-term acceptance of their monitoring systems.

Farmers were mentioned as the primary target group by 18 of 20 countries with data for structure and contents health reports. Vertical statistics (time-courses of health events within herd) were in 90% of the countries routinely included, whereas horizontal statistics (comparisons across farms by regional and/or national averages) were in only 55% of the countries routinely included in the health reports. However, possible comparisons between herds may be an important factor for ensuring continuous data flows, because they may advantage health monitoring systems over regular herd management software with their sometimes very distinguished within-herd analyses.

Information on GE for direct health traits was provided by 14 countries with advanced projects or routines for health improvement. The trait spectra were clearly influenced by the data collection approaches: Mastitis was considered in 13 countries, reproductive disorders and metabolic diseases in 8 countries each, claw diseases in 3 countries, and other limb diseases in only 2 countries. When comparing these GE focusses with study results for disease focusses

(Koeck et al., 2011; König et al., 2008; Zwald et al., 2004), claw and limb diseases may be underrepresented due to the yet incomplete collection of information on the locomotor system. Figures are likely to change in the future with wider use of owner-recorded data and claw trimming records.

Answers referring to information on other functional traits, for example calf weights (calving traits) or pregnancy testing results (fertility traits), indicated potentials for refined definitions of functional traits in the future. Proportions of data recorded, but not (yet) used for GE ranged from 9-62%. The use of data from automatic milking or feeding systems was found to be very limited yet: Body weight was recorded and considered for GE in 4 countries, feed intake in 2 countries.

Statements on the future perspective of functional traits were received from 25 countries, 20 of which expected an increase of the number of functional traits with published EBV in the near future (5 years) in their countries. Expectations regarding the most intense R&D activities were dominated by reproduction (N=12), followed by metabolism and efficiency (N=7) and longevity (N=6). Udder health, feet and legs and others (related to calf-development or health) were mentioned by only 4 countries each.

Asked for the main problems in recording and use of functional traits, motivation aspects (farmers, N=18; other people involved, N=11) and costs (N=16) were mentioned by most countries. Stratification by the current status of health data analyses as the area of functionality with most R&D activities revealed higher rating of motivation when compared to costs in countries with ongoing health projects (Table 4).

Table 4. Main inferences with extended functionality orientation in 25 countries by their status of health data analyses.

Group of people	No. of countries	
	no plans or planning status (N=12)	project status or routine (N=13)
Costs	8	8
Data ownership and data security issues	3	3
Lack of appropriate infrastructure on farm	4	5
Data are not available in a common data base	5	4
Motivation of the farmers	8	10
Motivation of other persons involved	5	6
Others (time, harmonization of recording)	1	1

Statements on possible help and support of the Functional Traits Working Group were received by 17 countries. Guidelines for new groups of functional traits were considered helpful by 6 countries, whereas 16 countries requested the organization of (multidisciplinary) workshops or seminars focusing on certain functional traits.

Conclusions

Information collected on past, current and future activities of different countries to improve functionality designated health as the area of most intense R&D activities and reproduction as the

area of most urgent need for future R&D. With the recent activities of the Functional Trait Working Group, i.e. finalizing ICAR guidelines for Recording, Evaluation and Genetic Improvement of Health Traits and drafting ICAR guidelines for Recording, Evaluation and Genetic Improvement of Female Fertility, therefore clearly met the needs of the ICAR members. Although the importance rankings of functionality aspects differ in dairy and beef cattle, recommendations for recording and analyses may be largely independent of the breed type, allowing a wide scope of the guidelines.

The major task of the Functional Traits Working Group will now be the coordination of expertise exchange to promote implementation of functionality improvement programs according to the standards of ICAR. In this context, interdisciplinary workshops and seminars may provide suitable and welcome platforms for exchange of knowledge and experiences.

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