PFT: The New Selection Index for the Italian Holstein

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Abstract

At the beginning of 2002 the Italian Holstein selection index has been changed. The new index, called PFT, has substituted the old ILQM, which has been the selection index of the Italian Holstein breeders since 1993. The introduction of a new selection tool was due to the larger costs caused by the increase of health problems, a high concern for somatic cells level and a lower feet & legs functionality. All these factors have reduced cow longevity and increased involuntary culling, reducing the breeder's profit. The PFT (Production, Functionality and Type) is an index that allows breeders to select bulls and dams for simultaneous improvement of both production and functional traits. In order to achieve this goal the 80:20 relative emphasis between production and udder health placed in the ILQM, was move to a ratio of 60 to 40 in the PFT. The production component of the PFT includes fat yield (12%), protein yield (42%), fat % (2%) and protein % (3%). Functional components include udder traits(13%), somatic cell score (8%), functional feet & legs (6%), combined longevity (10%) and type (4%). The relative emphasis for each trait was based on the achieved rates of genetic progress. The correlation between aggregate genotype of the old ILQM and the new PFT is 0.94 and a certain re-ranking occurred among bulls and cows. Nevertheless when selecting on PFT, milk, fat and protein yields are, respectively, 10, 5 and 2 % higher compared to old ILQM. Selection for yield has a negative effect on components and udder traits (ICM), but response on functional traits are straightforward. Type improves by 6%, Functional feet and legs (IAP) by 32 %, combined longevity by 52 % and SCS by 112 %. The results obtained support the idea that the PFT will help the Italian breeders to have in their herds high producing and healthy cows.

Keywords: selection Index, functional traits, breeding objective

Introduction

Since 1993 the ILQM index has been the selection tool provided by ANAFI to the Italian breeders.

The goal of the ILQM was focused on the importance of protein yield for cheese production and quality of milk, and of cow functionality, by means of her mammary system, for cost reduction.

The emphasis on protein yield was due to the fact that nearly 70% of the yearly national milk yield is for cheese production.

The ILQM placed relative emphasis of –20.8% on milk yield, 5.6% on fat yield, 53.6% on protein yield, 3.8 % on fore udder, 3.4% on rear udder height, 4.2% ligament, 5.2% on udder depth and 3.4% on teat placement, achieving a ratio production: conformation of 4 to 1. The relative weights of yield and milk contents were determined in a quota situation for fat yield (Rozzi, 1989).

The ILQM has been well accepted by the Italian breeders and the positive genetic trend observed in the Italian production level during nearly 10 years of selection (+ 997 kg for milk yield, + 39 kg for fat yield and + 36 kg for protein yield), clearly demonstrates the effectiveness of ILQM as selection tool.

Nevertheless in recent years the Italian breeder has begun to demand for something more complete. This need comes from the awareness that in spite of the increasing production, and

hence the increasing incomes, there have been larger costs, due to the increase of health problems, somatic cells and a lower feet & legs functionality. All these factors have reduced cow longevity and increased involuntary culling, reducing the breeder's profit.

Due to these requests the ANAFI resolved to change the national Selection Index, aiming to set up a more efficient and modern selection tool, which might allow the breeder to increase his profit, not only through the improvement of the production yield but through a more functional cow.

Preliminary meetings involving breeders and other members of the industry took place last year in order to define the new selection objective and to construct an efficient overall genetic merit. The result of this work is the PFT, the new Italian selection index. This paper presents the new traits included in the PFT, their relative weights and the effect on selection when using this new tool.

1. Development of PFT

PFT stands for Production, Functionality and Type, stressing the importance of its three main components an it was officially adopted in February 2002 evaluation.

The first step in establishing the PFT was to summarise the breeder's desires. This was done in several meetings, which took place all over the country.

In a such a way it was possible to define the most important topics that had to be considered when setting up the new index:

1) reduce emphasis on production, increasing the weight on functional traits
2) remove the negative emphasis from milk yield
3) incorporate somatic cell score
4) introduce more direct measure of longevity and conformation

Based on these guidelines, the ANAFI staff submitted some proposals and these were discussed by the Technical Committee. Each proposal was evaluated based on the achieved rates of genetic progress.

Table 1 provides a summary breakdown of the traits included in the new PFT, as well as their relative emphasis and standard deviation, based on the proposal which was officially approved by the Technical Committee.

The new PFT placed 60 % emphasis on production and 40% on functionality, resulting in a formula as follows:

PFT = 12.3 * [0.41*fat kg + 1.75*protein kg + 0.095*fat%*100 + 0.33*prot%*100 + 5*type + 12.15*ICM + 8*IAP + 8*(LONGEVITY-4) + 10 * (scs-4)]

where fat, protein, fat%, prot%, type and scs are direct breeding value for each trait and ICM, IAP and LONGEVITY are sub-indexes, respectively, for udder conformation, functional feet & legs and functional longevity.

Some of these indexes and sub-indexes were already available for the breeders (namely fat and protein %, type, ICM and IAP) even if they were not included in the ILQM index, while SCS EBV and the functional longevity sub-index have been recently introduced.

The factor 12.3 in the above formula is a scale factor that gives the PFT a standard deviation of 800 kg while all the other coefficients are the ratio of the relative weight to the standard deviation for each trait.

2.1 Production component

A large proportion of the herd's incomes still derives from the sale of milk production and the Italian breeders demanded for a stronger selection intensity on milk yield. For this reason the negative weight placed on the milk volume in the ILQM has been eliminated and a stronger emphasis has been put on fat kg. Relative weight on protein kg has been reduced of about 2 % (42 vs 53), and new weights on milk components have been added.

2.2 Functional component

The most important changes introduced by the PFT regard the objective of promoting long-lasting cows that might withstand the stress of high production over several lactations. This

means less somatic cells, less problems to the locomotory organs and a better mammary system. The ICM sub-index, including EBVs for fore udder (19%), rear udder height (17%), ligament (21%, udder depth (26%) and teat placement (17%), was included in the ILQM as indirect indicator of functionality but it had to be supported by other and more direct tools. According to those needs four (4) functional-related traits have been introduced in the PFT: somatic cell score, functional feet & legs, combined longevity and type.

2.2.1 Somatic Cell Score

Somatic cell count can be used as an indirect measure to identify both clinical and sub-clinical mastitis. Breeders are highly interested in reducing mastitis incidence and somatic cells not only because of the high veterinary costs but also because of the direct influence of SCS on milk price. As example table 2 relates the economic costs per milk litre relative to different levels of somatic cells in 5 Italian regions (namely Lombardia, Emilia Romagna, Friuli Venezia Giulia, Liguria and Abruzzo). In some areas the reduction can be higher, particularly where the milk is used for cheese production (ex. Parmigiano Reggiano area). For this reason bull EBVs for somatic cells are now calculated as part of the Italian genetic evaluation (Samoré *et al.*, 2001). Breeding values are expressed relative to a genetic base (cows born in 1995) in deviation standard units, with a higher values corresponding to higher resistance to mastitis. The EBVs are re-scaled to a mean value of + 4, and values range from 0 to + 8. This index was officially adopted in November 2001 evaluation.

2.2.2 Functional Feet and legs

In May 2000 evaluation a new index combining three linear traits related to locomotory system and the feet&legs functionality (scored subjectively by the classifier) was introduced. It was named IAP:

IAP = 0.50* feet&legs functionality + 0.50 (0.48*foot height + 0.37*rear leg rear view – 0.15*rear leg side view)

where each factor corresponds to relative emphasis.

The objective of this new index was to supply breeders with a more comprehensive and direct selection tool for locomotory system functionality. The standard deviation of the index is 0.75 (table 1).

2.2.3 Combined longevity

The importance of longevity is increasing in dairy cattle populations all around the world.

The above related traits have a strong influence on cow's longevity but the breeder do needs a direct indicator of which animals are able to remain sound and healthy in his herd, regardless of the production level or of his skilfulness to delay involuntary calving.

Genetic evaluation for functional longevity based on sire's daughters survival is available for Italian Holsteins since the end of 2001 (Schneider *et al.*, 2000). Actually the available index is not the EBV for direct survival. Due to low heritability and the fact that for young sires at the time of evaluation most of their daughters are still alive, the reliability of the EBV is low. One of the solutions to augment reliability is the combination of the information from direct survival with type trait information (Schneider *et al.*, 2000, Colloeau *et al.*, 1999). After some researches conducted at ANAFI the direct information on longevity of sire's daughters was combined with the indirect information on udder traits (ICM) and functional feet and legs (IAP) using MACE procedures. Table 3 shows the correlation between direct longevity EBVs and breeding values for udder traits and functional feet and legs. As SCS EBVs, the Combined Longevity EBVs are expressed with a scale ranging from 0 to about 8.

2.2.4 Type

Including Type EBVs in the new selection index not only puts more emphasis on functionality but at the same time it answers to the breeder's demand for more conformation, contributing to overall longevity. The EBVs for type have a standard deviation of 1 and are included in the PFT with a 5% relative weight.

3. Effect on selection

The correlation between aggregate genotype of the old ILQM and the new PFT is 0.94. This means that a certain reranking occurred among bulls when the PFT was introduced: 30 bulls out of 100 were different between November 2001 and February 2002 evaluation. Reranking among cows was even more significative.

Those results were expected because of the different selection objectives between the ILQM and the PFT. The influence of functional component increased from 20 to 40 percent and the number of traits included in the index increased from 4 to 9.

The results of selecting for PFT are presented in table 4 and compared with the results obtainable using the old ILQM. In the same table the relative weights of the two indexes can be found. The responses refers to a 10 year-selection period.

When selecting on PFT, milk, fat and protein yields are, respectively, 10, 5 and 2 % higher compared to old ILQM. Selection for yield has a negative effect on components and udder traits (ICM), narrowing their improvement. In spite of this slowing down on components and udder, response on functional traits are straightforward. Type improves by 6%, Functional feet and legs (IAP) by 32 %, combined longevity by 52 % and SCS by 112 %.

Looking back at the breeders' requests, it seems that the PFT is the right answer. The major concern among the Italian breeders was to have high producing and healthy cows and PFT can be used to select bulls whose daughters have such qualifications.

4. Conclusion

- Including extra traits directly or indirectly related to health and functionality, the new selection tool supplied to the Italian farmers is more complete than the old ILQM. Selection based on PFT will help to decrease all the costs caused by sanitary problems, involuntary culling and high replacement, augmenting the breeder's profit.
- The influence of production component in PFT is reduced from 80 % to 60 %, giving more weight to functionality.
- New traits or sub-indexes were introduced in the PFT, due to the new selection objective.
- Re-anking of bulls and cows was consistent and clearly demonstrates that the old ILQM was not the correct tool for selecting both production and functionality.

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Table 1. Relative weights and genetic standard deviations for traits used in PFT.

Trait		Weight	Std. dev
Fat		12	31
Protein	Production	42	26
Fat %	60 %	2	0.20
Protein %		3	0.09
Type		4	0.77
ICM		13	1.08
IAP	Functionality	6	0.79
Combined	40 %	10	1
Longevity			
SCS		8	1

Table 2. Economic costs per milk litre of different somatic cells levels in 5 Italian regions.

Somatic cells level	cost (euro/litre)
< 150.000	+0.003
150.000-300,000	+0.005
300-001-350.000	0
350.001 - 400.000	- 0.003
> 400.000	- 0.005

Table 3. Correlation between direct longevity, udder traits (ICM) and functional feet & legs (IAP).

	Direct longevity
Udder traits	0.48
Functional feet & legs	0.14

Table 4. Response to selection when using ILQM (1993-2001) and PFT (2002).

	Weight		Response	
Trait	ILQM	PFT	ILQM	PFT
Milk	-21	0	1287	1425
Fat	5	12	58	61
Protein	54	42	48	49
Fat %	0	2	0.08	0.07
Protein %	0	3	0.07	0.04
Type	0	4	1.29	1.37
ICM	20	13	1.65	1.46
IAP	0	6	0.93	1.23
Combined	0	10	29	44
Longevity				
SCS	0	8	-0.16	-0.34