Economic values for milk production and composition traits in the South and Southeast regions of Brazil.

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ABSTRACT: Economic values (EV) for milk, protein and fat productions, (MY, PY, FY, respectively) were obtained to compose an economic index to rank animals involved in an international genetic evaluation program of Holstein cattle used in the commercial dairy population in Brazil, taking into account the main milk production systems (MPS) prevailing in the South and Southeast regions. Seven MPS were defined based on the feeding management and production level of herds. Feeding costs were obtained from the regional prices of the components of diets. Payment tables from seven different milk industries were combined through linear regression analyses to obtain milk revenues. EV were calculated from the marginal differences between revenues and costs, for the interest of maximizing profit, assuming a stabilized herd. The average economic values (US$) for MY, PY and FY were, 0.28, 3.54 and 1.07, respectively. Changes observed in the last years in the milk market in Brazil have made selection for milk components economically advantageous.
Keywords: Dairy cattle; Economic values; Production circumstances

Introduction

The implementation of selection indexes has been an important step in the evolution of the dairy industry in the developed countries. Initially considerable emphasis was put on production traits in breeding programs (Wilmink, 1988, Harris, 1998). Miglior et al. (2005) surveyed the selection indexes of fifteen countries, from different geographical regions, taking into account the participation in the Interbull International Evaluation Program and size of progeny testing programs. Average relative emphasis for production, durability and health and reproduction, across all countries, was 59.5, 28, and 12.5%, respectively, showing that production is still the most important component in selection indexes used in dairy cattle. Studies on the definition of breeding goals based on calculated economic values for production and some functional traits for dairy cattle in Brazil have been developed for very punctual situations or based on theoretical possibilities. (Vercesi-Filho et al., 2000; Madalena, 2000; Martins et al., 2003; Cardoso et al., 2004, Bueno et al., 2004). Possible factors contributing for the delay of the implementation of breeding programs for dairy cattle in Brazil were: organizational difficulties of the sector, economic instability, absence of systematic milk recording programs, absence of milk payment policies accounting for composition and quality traits, etc. A regulatory program, establishing standards for composition, quality and health traits of milk was proposed by the Ministry of Agriculture in 2002, which began to influence payment policies of dairy industries around 2005 in the South and Southeast regions of the country. As a result, the number of industries applying some sort of bonus or penalties based on this milk quality regulatory program has increased and this influence on the final milk price has become more evident. The aims of this work were to obtain economic values for milk production and quality traits, for the main milk production systems prevailing in the South and Southeast regions of Brazil that could be used in the development of an economic index to rank animals in a breeding program in Brazil.

Materials and Methods

Information on the performance of Holstein Friesian and crossbred cows (Holstein x Zebu) included in the present study belonged to herds involved in a dairy program of data recording, management and breeding decision aid and genetic evaluation of animals, developed since 2008 by a subsidiary of an international breeding company operating in Brazil. Milk production systems were defined according to the feeding management and production level of herds for the Southeast region (represented by the states of Minas Gerais and São Paulo) and South region (represented by Parana state). Diets were defined according to the proportion of each component, expressed in dry matter.

Defined MPS in the Southeast region (SE) were: 1) *Confined:* cows kept in free stall during the whole year, receiving 60% corn silage and 40% concentrates (22% of crude protein – CP); 2) *Semi-confined:* cows kept in free stall during daytime, grazing during the night period, receiving 60% roughage (50% corn silage and 50% pasture) and 40% concentrates (22% CP), during the rainy season and 60% corn silage and 40% concentrates (22% CP), during the dry season; 3) *Rotational grazing with supplementation of corn silage during the dry season:* cows are kept in pastures of *Panicum sp*., or Elephant grass during the whole year, consuming 65% roughage (100% from grazing) and 35% concentrates (18% CP) during the rainy season and 60% corn silage and 40% concentrates (22% CP) during the dry season; 4) *Rotational grazing with supplementation of the mixture of sugar-cane and urea during the dry season:* cows are kept under grazing regime the whole year (*Panicum* sp.), receiving 75% roughage (100% coming from grazing) and 25% concentrates (18% CP) in the rainy season. In the dry season, cows receive 70% roughage (100% mixture of sugar cane plus 0.5% urea) and 30% concentrates (22% CP).

Defined MPS in the South region (S) were: 1) *Confined:* cows kept in free stall during the whole year, receiving 50% roughage (60% corn silage and 40% pre-dried oat or rye grass) and 50% concentrates (18% CP); 2) *Semi-confinement:* cows kept in free stalls during daytime, grazing during the night period, receiving 50% roughage (50% corn silage, 30% pre-dried oat or rye grass and 20% from grazing on oat or rye grass pastures) and 50% concentrates (18% CP); 3) *Rotational grazing with supplementation of corn silage during the dry season:* cows receiving 50% roughage (100% from grazing on Tifton pastures) and 50% concentrates (18% CP), during the raining season. During the dry season, cows receive 50% roughage (50% of corn silage and 50% oat / rye grass pastures 50% concentrate (18% CP).

Feeding costs of lactating cows were calculated for each MPS considering the prices, energy contents and amounts of the different components offered to animals. Prices of diets components of the different MPS were taken from regional economic reports and from the market.

Excel sheets were elaborated to obtain the average net energy content of feedstuffs that would be necessary to meet the estimated energy requirements calculated above and their respective prices, expressed both in *Mcal* and in kilograms of dry matter, taking into account the different compounds of the different diets and seasons of the year (rainy and dry seasons and respective lengths expressed in months).

Base milk price is the average milk price considering the states of São Paulo, Minas Gerais and Paraná for the period of 2009-2011 (US$0.39). To this base price, bonus or penalty values for protein and fat percentages were added, according to the situation, to compound final milk prices. The average exchange rate was US1.00 = R$1.81 for the same period.

Each milk plant or industry has its own criteria to define bonus and penalty classes. What they have in common is the absence of bonus or penalty values for classes around the minimum limits established by the Ministry of Agriculture regulation program for fat (3%) and protein (2.9%) contents and around the maximum limit of 400,000 somatic cell counts. To overcome this difficulty, all payment tables, with respective class definitions for protein and fat % (P% and F%, respectively), from seven different industries operating in the studied regions were combined. Then, using linear regression analysis it was possible to establish a relationship between fat and protein percentages and their additional values paid across industries. Data files, containing all average class intervals values, defined according to each company for each component, and respective additional payment values were used to carry out regression analyses. Linear regression parameters were obtained using the SAS package (Statistical Analysis System). Final milk prices were estimated by adding the estimated additional values for protein and fat percentages to the milk base value, as:

$$Y = A + bx$$

where Y is the estimated additional value for P% and F%; A is the intercept; b is the parameter and x is the class interval of payments for P% or F%.

Economic values (EV) were calculated according to the selection interest of maximizing profit (revenues – costs), assuming a fixed number of cows in the production system (Groen et al., 1997).

$$\text{EV, profit} = (1/n) * [\delta \text{ (annual profit)} - \delta \text{ (annual revenues)}]$$

δ = marginal difference of annual revenues (or costs), resulting from a one unit increase of each trait due to genetic improvement, keeping the level of the other traits constant.

Economic values for MY, PY and FY were calculated for each MPS and region. A bio-economic model using Excel sheets was developed, where the energy requirements of lactating cows, as well as the revenues and costs were calculated according to the average performance of cows based on test-day milk recording data.

To obtain the EV for one extra kilogram of milk, the marginal difference between revenues and costs to produce one kilogram of milk with 2.9 % P and 3.0 % F was considered.

To calculate EV for protein and fat yields, the original contents of these components, were increased by 1% (one at a time, keeping the other constant), and costs and revenues were recalculated. The differences in profit due to the increase by 1% in protein and fat contents were multiplied by the average 305-day milk production of cows in each MPS and then the economic values were expressed in terms of one kilogram of each component.

Results and Discussion

The average performance level of milk production and protein and fat percentages for MPS1 (SE), MPS2 (SE), MPS3 (SE) and MPS4 (SE) were, 8,845 kg, 3.75% and 3.14%; 7,015 kg, 3.52% and 3.24%; 6,100 kg, 3.93% and 3.30%, and 3965 kg, 3.52% and 3.22%, for 305-day milk yield, %F and %P, respectively. The performance of herds in Parana was very similar and due to the small number of herds in MPS1 and MPS3, they were grouped together and the average 305-day milk yield, %F and %P were 8,375 kg, 3.61% and 3.17%, respectively.

Table 1 shows the energy contents and prices of diets, calculated according to the MPS and region. It was observed that production levels, energy contents and prices of diets were compatible with intensification level of MPS in the Southeast region, with MPS1 showing the highest production level and feeding costs and MPS4 showing the lowest milk production level and feeding costs. Diet prices did not differ for MPS in the South region.

Table 1. Energy content (Mcal) of 1 kg of dry matter and diets price (US$), expressed in terms of kg of dry matter and Mcal, according to milk production system and region (SE or S).

Milk Production System	Mcal/kg DM	Price/kg DM (US$)	Price/Mcal (US$)
1 (SE)	1.68	0.30	0.18
2 (SE)	1.64	0.28	0.17
3 (SE)	1.58	0.24	0.15
4 (SE)	1.47	0.18	0.13
1 (S)	1.37	0.22	0.16
2 (S)	1.52	0.24	0.16
3 (S)	1.57	0.25	0.15

Linear regression equations obtained for the calculation of additional payment values for P and F contents (R^2 of 0.85 in both cases) used in the composition of milk price were:

*Additional P% = -0.2324 + (P %*0.0797)* and
*Additional F% = -0.1473 + (F %*0.0459)*

Table 2 shows the economic values for MY, PY and FY, according to the MPS and region.

Table 2. Economic values (US$) for milk, protein and fat productions, expressed based on one kilogram of each trait, according to milk production system and region (SE or S).

Milk Production System	Trait		
	Milk (kg)	Protein (kg)	Fat (kg)
1 (SE)	0.28	3.43	0.88
2 (SE)	0,28	3.47	1.13
3 (SE)	0.29	3.59	1.15
4 (SE)	0.31	3.72	1.38
1 (S)	0.28	3.52	1.04
2 (S)	0.28	3.52	1.05
3 (S)	0.28	3.54	1.07
Average SE and S	*0.28*	*3.54*	*1.07*

All economic values were positive, reflecting the effectiveness of the implementation of Government regulatory program on payment policies of industries for milk components. Economic values were calculated for each MPS. In general, MPS with higher feeding costs generated lower economic values for all traits (Table 4). Observing these results, however, we see that except for the slightly higher values found for MPS4 (SE), all values were very close and it would be advisable to work with average values (US$0.28, US$3.54 and US$1.07, for MY, PY and FY, respectively), given differences were small and are not expected to interfere with the direction of economic responses to selection.

It is important that breeding programs can reach a higher percentage of the animal population and that a greater number of animals are tested under different management circumstances. In addition, genetic improvement is future orientated, therefore the broader the knowledge of the economic impact of selection on different traits, the closer realized and predicted responses will be. It is clear that economic values must be reviewed on a regular basis, given unexpected factors may occur and causing important changes in production and commercialization circumstances of the different regions.

So far, any selection index has been applied in dairy cattle genetic evaluation programs in Brazil. The proposition of economic indexes for milk production traits can be considered an important step for the local dairy cattle breeding. As the amount of information on other traits of importance increases (economic functional type, health and fertility traits), new traits could be considered in the genetic evaluations and more comprehensive indexes could be elaborated to rank animals in breeding programs. Although we had information on SCC available, there is a great discrepancy among the different payment policies for SCC at the moment and we concluded that it would not be advisable to obtain an economic value for this particular trait. Alternative ways of including SCC in a selection index for dairy cattle selection purposes will be considered in the future.

Conclusions

The changes observed in the last few years in the milk payment policies by the dairy industries in Brazil were effective to make the selection for milk components (protein and fat) economically advantageous.

The small differences in economic values for milk, protein and fat between the different milk production systems involved in the present work indicate that it is possible to develop an economic index based on average economic values obtained for milk, protein and fat production, to be used in breeding programs in Brazil carried out in Southeast and South regions, the main milk production regions in the country.

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