Longevity in Dairy Cattle

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Abstract

Longevity of productive life in dairy cattle is a characteristic difficult to evaluate. This measurement is complicated, in part, because the phenotype is expressed late in the life of the animal, but also because the methods of evaluation are complex. The molecular bases of longevity are still far from being fully understood, although some genes begin to be associated with this characteristic. In this short communication will be discussed the criteria for selection in dairy cattle and to report some studies evaluate the molecular bases of longevity; your progress and current perspectives of selection by genic information.

Keywords: Molecular bases; Productive life; Selection; Type traits

Introduction

The genetic improvement programs of dairy cattle have selection criteria different to achieve the end goal of increasing production of milk with a lower cost of herd maintenance. One of point to be considered by milk producers is to set up heifers and cows healthy, fertile at the appropriate age, able to express their maximum genetic potential for a long productive period [1]. However, one challenge still present in dairy cattle is the short productive life of animals, called longevity. Longevity is not a trait easily measured due the delayed recording of phenotypic data, which would increase the generation interval [2,3].

Reduction of calving number generates a reduction of cow permanence time in the herd, influencing directly on profitability of dairy production [4]. A short productive life limits the selection opportunities on futures dam, cause high economic losses, besides being related to animal welfare [1]. Considering the importance of dairy business on a global stage is essential identify not the most productive animals only, but animals which combine best production, reproduction, longevity and conformation, resulting in animals that contribute to the increased profitability of the production system in general.

During the last decades, several statistical methods for survival analyses have been proposed, such as the proportional hazard model [5]. This procedure has been broadly implemented in several countries to predict breeding values for longevity [2,6].

Selection for Longevity

Direct selection

A longer the permanence of cows in the herd implies at a lesser number of heifers for replacement. Replacement of cows by heifers may be because to involuntary factors of production, such as problems related to udder ligaments, angulation, diseases, infertility and low speed of milking.

Dispose based on low production of milk is called voluntary disposal and discharges determined by other factors are called involuntary disposal [4]. Involuntary disposal is important to reduce the animal suffering, besides being an indicator of the condition of animal welfare; high rates of involuntary disposal may indicate problems of herd management. However, animal disposal is a strategy of high cost, since the price of an eliminated cow is generally lower than the replacement price of a heifer [7].

Some criteria are used to select animals for disposal, such as (1) cows with negative pregnancy after 120 days of lactation, (2) cows that remain dry for more than 70 days, (3) serious health problems, (4) chronic infections requiring continuous treatment, (5) high somatic cell count, (6) physical defects that affect production or (7) that require special care, (8) low production or (9) not conducive to the genetic improvement herd. But above all, the economic criterion is important to be considered for the permanence of an animal within the herd [8]. Currently, the discards considering only the economic criteria is decreasing, mainly because the most widely used criterion is to select the animal genetic merit for milk production [9]. However, the correlation of milk production and other functional traits, such as fertility and disease resistance should be considered [10-12].

Indirect selection for longevity based on linear type traits

Although milk production is considered one of most important products in the dairy farming is important to determine their association with other traits [13]. Currently, type traits are measured within genetic improvement programs aiming to associate the traits type with milk production and used together with other data for selection to conformation, reproduction and longevity [14]. The purpose of the inclusion of type traits is to improve the cows conformation, providing a better body, functional and reproductive structure that enable them to meet the challenges of increasing production.

Linear types traits are used on selection for longevity because some have a positive genetic correlation, but mostly because have moderate heritability all the traits types are obtained early in the cow life [7,15]. The selection of type traits associated with longevity in the herd may be beneficial to reduce involuntary culling and thus increase

profitability [16]. The type traits that present a higher influence on cows longevity are the traits related to sections udder, feet and legs, such as: anterior insertion, texture, depth, height of rear udder insertion, insertion wide rear udder, central ligament, bone quality and angle of the hull [4]. In fact, the selection by width and height of posterior udder, udder texture, udder cleft, loin strength, bone quality and final score can lead to improvements in longevity and 305 milk productions [17].

However, the large number of linear type traits and the correlation among each other can lead to inaccurate estimates on longevity and milk production due to high collinearity with linear type traits [18]. An alternative to avoid the inaccurate estimates is the factors analysis, which removes redundant information among correlated variables defining a smaller set of derived variables, called factors (Vukasinovic et al., [18]). The factor analysis provides tools for examining the correlation structure in a large number of traits, defining traits sets that are highly interrelated [19].

Molecular Base of the Longevity

Genetic selection and management changes during the last decades have significantly increased the productivity in dairy cattle. However, this recent success has not correlated with an extension of longevity and reduction in replacement rate, being the short productive life one challenge still present in dairy farming. Longevity or lifetime production of cows is determined by a combination of environmental and genetic factors. However, there is no information on the molecular basis of longevity, which is far from being understood.

New alternatives are being made available through the molecular genetic that allow to determine the genetic potential of the animal with greater precision before the expression of its phenotype, which is late for longevity. Parallel with the traditional selection, some genes and their polymorphisms are being studied and tested for association with longevity, aiming to use the results aiding in the selection process. Data of genes associated with traits type and milk production are evaluated to be included in the model longevity. Genes such as butyrophilin subfamily 1 member A1 gene (BTN1A1), acyl-CoA: diacylglycerol acyltransferase 1 gene (DGAT1), leptin receptor gene (LEPR), leptin gene (LEPR), ATP-binding cassette sub-family G member 2 gene (ABCG2). The effects of DGAT1 and ABCG2 are known on the milk production traits, LEP and LEPR have contradictory results described in literature, while the effect of BTN1A1 has not been reported.

In fact, just LEP and polymorphisms were associated with longevity in Polish Holstein- Friesian cows, being considering consistent marker for longevity in this breed [20]. A single nucleotide polymorphic of the pituitary specific transcription factor 1 with domain POU gene (POUlFl) was associated with improved longevity and milk product traits in Holstein cows. A SNP variation (SNP10793 allele A) was associated with a significant increase in PTA for milk yield in the granddaughter design population but not in the daughter design [21,22].

The detection of genes associated with increased productive life in dairy cattle generates a great perspective for identification of a molecular marker associated with increased longevity. Molecular approaches will play an increasingly important role in the genetic evaluation and selection of dairy cattle. However, the effective integration of genetic information in the context of animal breeding still represents a great challenge in the area [23,24].

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