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# Prediction of Viability of Cows: a New Look at the Old Problem



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## Abstract

The use of intensive technologies in industrial livestock breeding has led to a reduction in the level of biodiversity, an increase in disease incidences and decline in reproduction. In dairy cattle breeding, the main efforts now are directed at control of morbidity, but solution of problems may be in another area, related to an increase in the overall viability of populations. The problem is to find the quantitative tests for early evaluation of the desired traits for targeted selection. The aim of this work is to present several methodological approaches for quantifying the viability of cows at the level of group (e.g., bull's daughters), herd or population.

## Introduction

The use of intensive technologies in industrial livestock breeding has led to an increase in negative trends, including a reduction in the level of biodiversity, an increase in disease incidences and decline in reproduction. In dairy cattle breeding, the main efforts are directed at the treatment of diseases of lactating animals, although the solution of problems may be in another area, not related to the treatment of sick animals, but to an increase in the overall viability of populations. It is known from practice that a good cow can be obtained only from a good heifer. Researchers know the phenomenon of "primal health" [1], so we should learn identify at a young age the long-standing groups with a high potential for protective functions and the ability to lactate. With the use of modern methods of large-scale selection of animals, the desired type of cattle can be obtained over several generations, when an effective quantitative test is known for early evaluation of the desired trait in the offspring. The problem is to find directions for research to develop such tests.

It is known that in critical periods of early development, external influences cause shifts in the emerging systems that can persist throughout life [2,3]. Mediating factors can influence gene expression without affecting the coding sequences of DNA, however, changes in expression patterns can sometimes be transmitted to offspring in some cases [4]. Potential candidates for the role of tests for assessing the viability potential should not be sought in terms of physiological homeostasis; they are more likely to be found in the area of long-acting factors of constitutive resistance [5]. For productive animals, term "constitutive

resistance" can be interpreted as the age-dependent functional capacity to ensure productive longevity and fertility. Similar problems are now being investigated in the field of personalized predictive medicine [6,7]. The aim of this work is to present several methodological approaches for early quantifying the viability of cows at the level of group (e.g., bull's daughters), herd or population.

## Assessment of parameters by the age dynamics of milk yield

The data of the milk yields for 305 days ( $y_{mi}$ ) on consecutive lactations in  $i$  groups of cows with different numbers of the last lactation ( $t_{i\max}$ ) are used, starting from 4 and further to culling. The age dynamics of milk yields is described by a three-component multiplicative function, in which the first component ( $A=\text{const}$ ) is potentially the maximum 305-d milk yield, second component  $\exp(-\exp(-bt))$  is the age-dependent increase in the capacity for lactation activity with gradual rise to plateau level, third component, the function  $D_i^t$  ( $D < 1$ , index of constitutive resistance), describes the age-dependent decline in ability to maintain lactation activity in  $i$ -th group. At smaller values of  $D$ , the peak of 305-d milk yield comes earlier and the cows drop out faster from the herd. The level of peak of milk yield is always less than  $A$  by a quantity that depends on the rate of decrease in constitutive resistance.

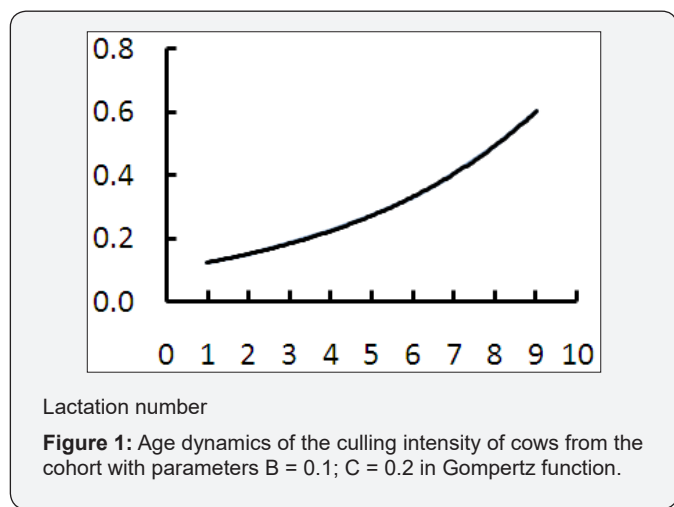
The study of data obtained for herds of several breeds revealed a positive relationship between the length of productive life (LPL) in groups of cows with the same number of the last lactation, and the corresponding values of  $D$  for these groups

[5]. The presence of a positive relationship between  $D$  and  $LPL$  indicates that the duration of the economic use of cows is determined to a certain extent by the level of constitutive resistance at first lactation.

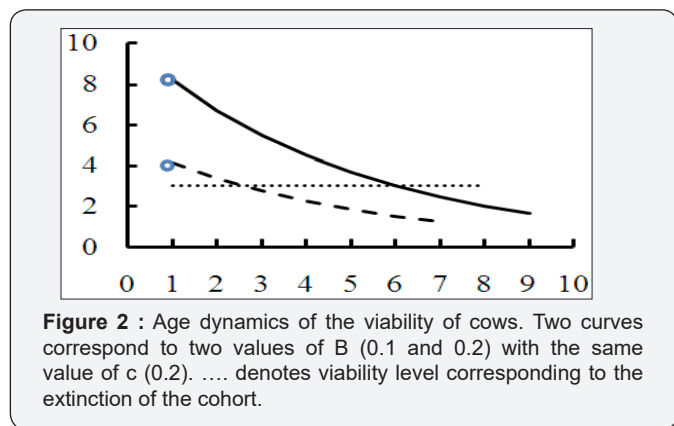
**Assessment of parameters by dynamics of culling rate of cows**

A similar relationship has been revealed when analyzing the dynamics of survival of cows in a herd. The dynamics of culling rate of cows from the herd (culling intensity from respective cohort when herd is in stationary state) in most cases is well approximated by the Gompertz function  $y_c(t)$  (Figure 1):

$$y_c(t) = \frac{\Delta S}{(S\Delta t)} = B \exp(ct)$$



where  $t$  is number of the current lactation,  $S$  is the quantity of cows in cohort,  $\Delta S$  is the difference in the number of cows at the previous and current lactation,  $\Delta t = 1$ ,  $B$  and  $C$  are constants. The function, inverse to the culling intensity (Figure 2), characterizes the age decrease of vitality.



At  $t = 1$ , the initial intensity of culling  $y_{c1} = Be^c$  is determined and, respectively, the initial level of viability is

$$y_{c1}^{-1} = B^{-1}e^{-c}$$

where  $y_{c1}$  is the intensity of culling at the first lactation (the difference in the number of cows on first and second lactation,

divided by the number of cows on first lactation). When analyzing the survival dynamics of cows in herds of several breeds, the existence of a positive relationship between  $LPL$  and

$1/y_{c1}$  was revealed [5]. So,  $1/y_{c1}$ , in meaning is identical to  $D'$  and parameters  $D$  and  $1/y_{c1}$  may be considered as candidates on the role of predictors of  $LPL$ .

These interrelationships are compatible with concepts well known in the biology of aging. In all animals, after entering the reproductive period, an exponential increase in the death rate is observed and, accordingly, an exponential decrease in the reciprocal of this value, i.e. in the level of viability, so that at definite time the organism comes into the range of values of key parameters that are incompatible with life. Figure 2 illustrates this situation for two cohorts of cows with the same value of  $c$  and two levels of  $B$  in the Gompertz function.

In this case, since  $1/e^{0.2} = 1/1.22 = 0.82$ , the initial values of  $1/y_{c1}$  for the two variants (marked by circles) are: 1)  $1/y_{c1} = 10 \times 0.82 = 8.2$ ; 2)  $1/y_{c1} = 5 \times 0.82 = 4.1$ , and two values of  $LPL$  (6.2 and 2.5 lactations) are determined at the point of intersection with the critical level of viability. In this situation,  $1/y_{c1}$  may be considered as predictor of  $LPL$  for two cohort that have the similar values of parameter  $c$ .

**Conclusion**

The revealed interrelations provide a definite basis for understanding the factors that determine the age dynamics of viability and milk productivity of cows. The critical factor for longevity of dairy cows is the "initial" value of viability (primal health, initial constitutive resistance), that animals acquired at the onset of reproductive period. Therefore, in addition to the current struggle against diseases, the long-term research and developments must be performed aimed to increase the primal health of breeding stock. From this view-point, the targeted breeding, elimination of adverse influences during embryonic, fetal and postnatal development, and good technologies for the growing of heifer can increase the viability of cows and milk productive performance.

**References**

1. Odent M (1986) Primal Health. Century Hutchinson, London.
2. Vaiserman AM, Voitenko VP, Mekhova LV (2011) Epigenetic epidemiology of age-dependent diseases. Ontogenez 42(1): 30-50.
3. Gluckman PD, Hanson MA (2004) The developmental origins of the metabolic syndrome. Trends Endocrinol Metab 15(4): 83-187.
4. Pang S, Curran SP (2012) Longevity and the long arm of epigenetics: Acquired parental marks influence lifespan across several generations. Bioessays 34(8): 652-654.

5. Cherepanov GG (2014) Substantiation of the concept of the key role of constitutive resistance for the viability and duration of use of highly productive animals. Problems of Productive Animal Biology 4(5): 5-34.
6. Ginsburg GS, Willard HF (2009) Genomic and personalized medicine: foundations and applications. Transl Res 154(6): 277-287.
7. Offit K (2011) Personalized medicine: new genomics, old lessons. Hum Genet 130(1): 3-14.



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