Scientific Papers. Series D. Animal Science. Vol. LXI, Number 2, 2018
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

ESTABLISH THE SELECTION OBJECTIVE USING A COMPETITIVENESS INDEX FOR ROMANIAN BUFFALO

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Abstract

This study was conducted in order to calculate the competitiveness index for milk yield, fat and protein percent in the population of Romanian Buffalo from Șercaia Research and Development Station. A total 609 milk yield and associated characters records, belonging to 87 females, which coming from 11 sire families, for 7 lactations were analysed. The method used was an index elaborated by Sandu (1983) which takes into account the genetic determinism of traits, genetic correlations and economic weight. The method used for genetic parameters estimates was REML, and for economic weights was linear multiple regression. The competitiveness index for milk yield, fat and protein percent in seven lactations were calculated as: 0.1158, -0.0040, -0.0279; 0.0683, 0.0024, -0.0087; 0.0817, 0.0141, -0.0249; 0.5265, 0.0013, -0.1134; 0.1441, 0.0479, -0.0567; 0.1806, 0.0005, -0.0478; 0.3170, -0.0300, -0.0921. Results indicated that the selection objective of Romanian Buffalo is milk yield genetic improvement. But, taking into account the genetic correlations between traits, an optimization of the female selection criterion becomes mandatory.

Key words*: selection objective, competitiveness index, milk yield, fat and protein percent, Romanian Buffalo.*

INTRODUCTION

In Romania, the buffalo entered with the invasion of the Huns and Avars in the Carpatho-Danubian area. It found the good pedo-climatic conditions and so, in our country, has developed a buffalo population which had its own evolutionary path as a result of reproductive isolation (Vidu et al., 2008). The Romanian Buffalo is one of the most important genetic resources for milk and meat production.
At present, the buffalo herds in Romania have fallen further, reaching about 14,000 heads (personal estimation from the National Institute of Statistics data). In our country, buffalo is predominantly grown in individual subsistence households, with a maximum of 5 heads. Romania has a tradition of growing this species, but with the aging and biological disappearance of the rural population, the species is vulnerable. Also, the vulnerability of the Romanian buffalo is generated by the lack of financial aid, the low milk price, the lack of strong associations of breeders that protect farmers' interests in recent years. However, Romania has the major advantage of the existence of a research station in the field of buffalo breeding, which has an extremely valuable breeding nucleus. Increasing the economic efficiency of buffalo production and developing a breeding program are keys to actively conserving of this genetic structure.
The buffalo is a species with remarkable quality, of which we can remember: high percentage of milk fat, meat with exceptional taste qualities, resistance to diseases and heavy environmental conditions, good valorization of poor quality feeds. On the international market, the main product obtained from buffalo milk is Mozzarella, a cheese specialty. The amount of Mozzarella is closely related to the quantity and quality of milk (Popa et al., 2014) and is a criterion for the selection of buffaloes.
Enormous advantage of exploitation of this species for characters associated with milk production, compared with cows and sheep, is the lower cholesterol content of milk and Mozzarella cheese type, despite higher values of the constituents (Zicarelli, 2004).
Compared with cows, buffalo milk has quality parameters with higher values. The fat percentage range between 6.87 to 8.59% (Rosati and Van Vleck, 2002; Tonhati et al., 2000), protein percentage between 4.13 to 4.55% (Macedo et al.2001; Rosati and Van Vleck, 2002). In Romania, Velea and

Mărginean (2004) specifies that buffalo's milk production falls in to the following parameters: average milk yield 1111.11 kg/lactation, average fat yield 82.10 kg (7.39%), and average protein yield 46.21 kg (4.23%).
So far, no breeding program related to this species has been developed in our country. As is well known, setting the selection objective is a first step in developing breeding programs. The inclusion of traits in the selection objective is based on the economic weight, degree of genetic determination, and genetic correlation with other traits (Grosu et al., 2005; Popa, 2009). Developing a breeding program for this species is an active conservation path that aims to improve the genetic structure of the population for useful economic characteristics, thus contributing to the economic efficiency of the species.
There are a number of studies showing estimates of genetic parameter values related to buffalo milk yield and quality (Aspilcueta-Borquisetal, 2010; Farhangfar et al., 2003; Rosati and Van Vlek, 2002; Sarubbi et al., 2012; Seno et al., 2006; Tonhati et al., 2000), but very few related to estimation of economic weight (Bahareh et al., 2011).
The objective of this study was to establish the traits which will be included in selection objective, according to a competitiveness index, using a methodology that gives the maximum accuracy in conditions of the existence an inconsistent data.

MATERIALS AND METHODS

A total 609 milk yield and associated characters records, belonging to 87 females, which coming from 11 sire families, for 7 lactations were analysed.
The traits studied were: milk yield per lactation, milk fat and protein percent.
In control milk production, records with length greater than 270 days were truncated at this point, as suggested by Tonhati et al. (2008) and Aspilcueta-Borquisetal (2010).
In order to estimate economic weights and genetic parameter values, were used the data resulting following control milk production in females belonging Şercaia Research and Development Station. To analyze parameters in dynamic were included in the analysis only animals presenting records to an equal number of lactations.
The method used to estimate economic weights is based on the multiple linear regression proposed by Hazel in 1943 (Grosu, 2003, 2005).
These economic weights have been presented in another paper by the authors („Economic weights of production traits for Romanian buffalo" - in process of publication) and will be used to calculate the competitiveness index.
The competitiveness index was estimated using a relationship proposed by Sandu (1983):

$$C_i = \left(a_i \cdot h_i^2\right) + \sum_{i=1}^{j} r_{G_{ij}} \cdot (1-s) \cdot \left(a_j \cdot h_j^2\right)$$

in which:
- $i, j = 1, 2, ...,$ n traits, but $i \neq j$;
- a_i = economic weight of trait for whom the competitiveness index is computed
- h_i^2 = heritability of trait for whom the competitiveness index is computed
- $r_{G_{ij}}$ = genetic correlation between *i* and *j*
- a_j = economic weight of trait with which it compares *i*
- h_j^2 = heritability of trait with which it compares *i*
- $s = 0$ when *i*şi*j* must be modified by selection in the same sense and $s = 2$ when *i*şi*j* must be modified by selection in different sense
- $\sum$ shows us that there will be so many assemblies, how many traits we haves.

The method used for genetic parameters estimates was REML developed by Fisher (1925) and perfected by Patterson and Thompson (1971).

RESULTS AND DISCUSSIONS

The setting of economic weights is of dual importance: on the one hand, only the economic important traits are included in the selection objective, and on the other hand it determines the weight to be given in the selection of the different traits that contribute to the complex character (Drăgănescu and Grosu, 2003).
The economic weights for milk yield, fat and protein percent are presented in Table 1.

According to Material and method section, these economic weights have been presented in another paper by the authors („Economic weights of production traits for Romanian buffalo" - in process of publication) and will be used to calculate the competitiveness index.

Table 1. The economic weights for milk yield, fat and protein percent

Specification	U.M.	Milk yield (kg)	Fat percent	Protein percent
Lactation 1	euro	0.9636	0.1367	-0.0974
Lactation 2	euro	0.9729	0.0912	-0.0661
Lactation 3	euro	0.9948	0.1978	-0.1935
Lactation 4	euro	0.9922	0.1506	-0.1452
Lactation 5	euro	0.9932	0.2691	-0.2645
Lactation 6	euro	0.9891	0.1454	-0.1352
Lactation 7	euro	0.9820	0.1708	-0.1597

The values presented in Table 1 show that an increase of average of milk production with one kilo in one lactation period, the income will be increase with approximatively 1 euro. Also, the unitary increase of fat percent (one percent per lactation) will be a positive effect to the income of farm. The negative values associated with protein percent indicate that, at least in the analyzed population, it is not desirable to increase it.

Heritability is defined as the rate of additive genetic variance in the phenotypic variance. Since the breeding program can act only on additive genetic variation within population, estimates of heritability coefficients are considered very important as indicators of effectiveness of these programs. Heritability coefficient values for the traits studied in dynamics are presented in Table 2.

Table 2. Heritability values for milk yield, fat and protein percent

Specification	Milk yield	Fat percent	Protein percent
	$h^2 \pm s_{h^2}$	$h^2 \pm s_{h^2}$	$h^2 \pm s_{h^2}$
Lactation 1	0.12±0.27	0.13±0.27	0.14±0.25
Lactation 2	0.07±0.25	0.10±0.26	0.06±0.24
Lactation 3	0.08±0.25	0.13±0.28	0.11±0.24
Lactation 4	0.52±0.44	0.48±0.43	0.49±0.39
Lactation 5	0.14±0.28	0.25±0.32	0.20±0.35
Lactation 6	0.18±0.29	0.21±0.29	0.21±0.30
Lactation 7	0.32±0.35	0.26±0.32	0.32±0.34

Heritability coefficient values for milk yield that we found are similar to those reported by other authors (Farhangfar et al., 2003; Rosati and Van Vlek, 2002; Sarubbi et al., 2012; Seno et al., 2006; Tonhati et al., 2000). The milk yield is a character that has a low to medium genetic determinism, along the 7 lactations analyzed (Table 2). The variation of heritability coefficient from one lactation to another can be explained by the variation of environmental variance (taking into account all elements which contribute to its determination), or existence of different polygenic complex that is involved in genetic determining of milk yield.

Regarding the milk fat and protein percent, data presented in Table 2 show that these traits can be placed in group of low to intermediate heritable traits. Same discussion for values variation from one age to another.

Heritability coefficient values for milk quality that we found are similar to those reported by other authors (Rosati and Van Vlek, 2002; Sarubbi et al., 2012; Seno et al., 2006; Tonhati et al., 2000).

The genetic correlation values between traits studied in dynamics are presented in Table 3.

Table 3. Genetic correlation between milk yield, fat and protein percent

Couple of traits	r_G
Lactation 1	
Milk yield x	
- fat percent	-0.16
- protein percent	-0.22
Fat percent x	
- protein percent	0.24
Lactation 2	
Milk yield x	
- fat percent	-0.09
- protein percent	-0.25
Fat percent x	
- protein percent	0.15
Lactation 3	
Milk yield x	
- fat percent	-0.10
- protein percent	-0.22
Fat percent x	
- protein percent	0.17
Lactation 4	
Milk yield x	
- fat percent	-0.11
- protein percent	-0.26
Fat percent x	
- protein percent	0.20
Lactation 5	
Milk yield x	
- fat percent	-0.09
- protein percent	-0.21
Fat percent x	
- protein percent	0.13
Lactation 6	
Milk yield x	
- fat percent	-0.14
- protein percent	-0.24
Fat percent x	
- protein percent	0.18
Lactation 7	
Milk yield x	
- fat percent	-0.18
- protein percent	-0.21
Fat percent x	
- protein percent	0.35

The results presented in Table 3 show that milk yield is negative correlated with fat and protein percent, which means that long-term selection of females for quantity of milk is made in detriment of its quality. Results are similar with those obtained by Popa et al. (2014).

The values of competitiveness index calculated according to the described model for milk yield, fat and protein percent are presented in Table 4.

Table 4. Competitiveness index values for milk yield, fat and protein percent

Specification	Milk yield	Fat percent	Protein percent
Lactation 1	0.1158	-0.0040	-0.0279
Lactation 2	0.0683	0.0024	-0.0087
Lactation 3	0.0817	0.0141	-0.0249
Lactation 4	0.5265	0.0013	-0.1134
Lactation 5	0.1441	0.0479	-0.0567
Lactation 6	0.1806	0.0005	-0.0478
Lactation 7	0.3170	-0.0300	-0.0921

The values presented in Table 5 show that on the basis of the competitiveness index, the objective of selection in the Romanian buffalo population is the genetic improvement of milk yield, in all the lactations analyzed. The results obtained are supported by the large economic weight of the milk quantity and the importance of it for the quantity of Mozzarella cheese. It is very clear that, once the desired level of milk yield is reached, it may eventually improve the quality of it, especially the quality of protein.

CONCLUSIONS

The results regarding competitiveness index for selection objective establish indicates that, in analyzed population and according to our available data, the objective of selection in the Romanian buffalo population is the genetic improvement of milk yield. But, according to the genetic determinism of traits, became mandatory an optimization of the female selection criteria.

ACKNOWLEDGEMENTS

The paper work was elaborate based on researches financed by two grants: BIOBUFFALO no 169/2014 and ADER 8.1.1./2015.

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