Genetic parameters estimate for milk and mozzarella cheese yield, fat and protein percentage in dairy buffaloes in Brazil

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ABSTRACT: The aim of this study was analyze the (co)variance components and genetic and phenotypic relationships in the following traits: accumulated milk yield at 270 days (MY270), observed until 305 days of lactation; accumulated milk yield at 270 days (MY270/A) and at 305 days (MY305), observed until 335 days of lactation; mozzarella cheese yield (MCY) and fat (FP) and protein (PP) percentage, observed until 335 days of lactation. The (co)variance components were estimated by Restricted Maximum Likelihood methodology in analyses single, two and three-traits using animal models. Heritability estimated for MY270, MY270/A, MY305, MCY, FP and PP were 0.22; 0.24, 0.25, 0.14, 0.29 and 0.40 respectively. The genetic correlations between MCY and the variables MY270, MY270/A, MY305, PP and FP was: 0.85; 1.00; 0.89; 0.14 and 0.06, respectively. This way, the selection for the production of milk in long period should increase MCY. However, in the search of animals that produce milk with quality, the genetic parameters suggest that another index should be composed allying these studied traits.

Key words: Heritability, Genetic correlation, Milk composition.

INTRODUCTION - The Brazilian milk market has shown strong evidence in value the milk with different constitution, like in the international market, where more than two decades demands milk with higher total solids content, mainly fat and protein. Knowing the buffalo's milk productivity and nutritional index is a way to evaluate the animal performance related to it production potential, generating the milk bubaline exploration and the consequent milky products, specially the "mozzarella" cheese, being a good economic option to the farmers. According to Seno et al. (2006), considering the effective payment policy during the study, the fat and protein content selection is no desirable when the farm aim is selling the milk by itself, but is desirable when the aim is the "mozzarella" production. However, in according to Normative Instruction 51, 2002 (Brazil), the farmers should be produce milk with quality that it would change the selection sense. In this direction, the present work aims estimate the genetics and phenotypes parameters to these traits trying to check how these traits can be considered in a bubaline breeding program in Brazil.

MATERIAL AND METHODS - The analyzed information in this work came from the Bubaline Milk Control Program at São Paulo State University, Department of Animal Science (Universidade Estadual Paulista - UNESP), Faculdade de Ciências Agrárias e Veterinárias de Jaboticabal, SP (FCAV). The traits were colleted between 1985 and 2005 for approximately 4.389 lactations belonging to 13 farms in the São Paulo State. The evaluated traits were: accumulated milk yield at 270 days (MY270), observed until 305 days of lactation; accumulated milk yield at 270 days (MY270/A) and at 305 days (MY305); mozzarella cheese yield (MCY) and fat (FP) and protein (PP) percentage observed until 335 days of lactation. MCY was estimated by the total milk yield, fat and protein percentage by a formula reported by Altiero et al. (1989): MCY, kg = (MY305, Kg) * {[3,5 * (PP) + 1,23 * (FP) – 0,88] ÷ 100}. Animals presenting three standard deviations above or below the mean of their contemporary group (CG) were eliminated. Contemporary groups (CGs) containing only sons of the same sire and those with less than five animals for milk yield were excluded, whereas for MCY, PP and FP, CGs with less than three. The CG were defined through variables: herd (13), year (21) and season (rainy and dry seasons) of calving. The (co)variance components were estimated with the MTDFREML (Multiple Trait Derivative - Free Restricted Maximum Likelihood) software, developed by Boldman et al. (1995), in one, two and three-trait analyses using animal models. The model to the evaluated traits includes the direct and permanent environmental random effects, the CG and milking number (MN) fixed effects, thus animal age as linear and quadratic effects and linear effect to the lactation period (LP) as covariables. To MY270/A was used the linear and quadratic effects of the LP as covariable. Using the genetic and phenotypic parameters estimated in this work, direct and correlated responses between some traits were predicted. The same intensity of selection (i) for males and females, that is i = 1 (38% of individuals selected for reproduction), was used.

RESULTS AND CONCLUSIONS – Table 1 presents genetics parameters estimated in one, two and three-traits analyses. It was obtained also the heritability average estimates from the additive and phenotypic variance of all the two and three-traits analyses in each analyzed. It can be evidenced from moderate to high genetic variability to all milk yield traits (MY270, MY270/A and MY305 - MYs) and to milk composition (PP and FP). To MCY this variability was from medium to low magnitude. These heritability estimates obtained by two and three-traits analysis are still of same magnitudes and within the range of the heritability estimates by one-trait analysis, more or less one standard error, with exception of MCY. The MYs values obtained in this study had the same magnitude when compared Marques and Sousa (1999) and Tonhati et al. (2000) that varying from 0.24 to 0.30 in Brazilian herds. However, lower value was estimated by Rosati and Van Vleck (2002) to MY270 in Italian herds (0.14). This estimate showed Brazilian herds has been selecting with lesser intensity for MYs than Italian ones. Lower heritability values to PP (0.26) and to FP (0.21) were discovered by Tonhati et al. (2000). In the same way, but in lower magnitude, Rosati and Van Vleck (2002) estimated heritability of 0.10 (PP) and 0.17 (FP) in Italian herds. However, to FP, Marques and Souza (1999) estimated higher heritability (0.40) in two Brazilian buffalo's population. In a special way, these analyzed bubaline herds are not being selected intensively for milk quality traits. The heritability estimated for MCY was close to the estimative obtained by Rosati and Van Vleck (2002) in Italian buffalo (0.13). However the same authors related variance

components estimated higher (varying from 1,271 to 9,886 kg[2]) than in this study. The genetic and permanent environmental correlation estimated between MYs and MCY described in the Table 1 were from high magnitude, between 0.85 and 1.00, showing that these traits are determined in most of the case by the same group of additive gene action. In the same way, Rosati and Van Vleck (2002) obtained higher estimates of genetic correlation (0.95), between MCY and MYs traits. Nevertheless, these authors estimated moderate permanent environmental correlation (0.54). The MCY genetic association with PP and FP were low and positive (0.14 and 0.06, respectively). The estimated indicate that MCY produce lower correlated responses to these quality traits (0.01 to PP and to FP). The direct selection for PP and FP should expected higher gain, from 0.11 and 0.24, respectively. These results suggesting that the equation to calculate MCY should be studied for Brazilian conditions. Better responses for MCY would be expected by indirect selection for all MYs (10.58, 13.00 and 11.81 kg of MCY per generation) when compared direct selection (9.93 kg per generation). More over would be expected a higher selection intensity to all of the MYs, once they are easy to measure and they have a low cost, permitting a higher number of animals to be controlled. The genetic, phenotypic and permanent environment correlations between PP and FP were 0.46, 0.35 and 0.38, respectively (not showed). The genetic correlations between MYs and FP (not showed) were negative and low, close to -0.56 and between MYs and PP were close to -0.26.

Table 1. Genetic and phenotypic parameters estimate for milk and mozzarella cheese yield, fat and protein percentage in bubaline herds of São Paulo State – Brazil, evaluated in one, two and three-trait analyses.

Parameter	MY270[1]	MY270/A[2]	MY305[3]	MCY[4]	PP[5]	FP[6]
[a] $\hat{\sigma}^2_a$	29,623.42	33,564.09	36,905.87	704.05	0.03	0.21
[b] $\hat{\sigma}^2_t$	38,699.56	34,906.72	36,893.88	1,609.44	0.02	0.21
[c] $\hat{\sigma}^2_e$	66,798.23	68,863.63	72,723.55	2,719.69	0.03	0.29
[d] $\hat{h}^2$ (E.S.)	0.22 (0.04)	0.24 (0.04)	0.25 (0.04)	0.14 (0.07)	0.40 (0.09)	0.29 (0.09)
[e] $\hat{h}^2$ (Average)	0.22	0.25	0.26	0.22	0.42	0.28
[f] $\hat{c}^2$	0.29 (0.04)	0.25 (0.03)	0.25 (0.03)	0.32 (0.07)	0.24 (0.08)	0.30 (0.08)
[g] $\hat{e}^2$	0.49 (0.02)	0.50 (0.02)	0.50 (0.02)	0.54 (0.04)	0.36 (0.03)	0.41 (0.03)
[h] $\hat{t}$	0.51	0.49	0.50	0.46	0.64	0.59
[i] $\hat{r}_a$	0.85	1.00	0.89	-	0.14	0.06
[j] $\hat{r}_t$	0.98	1.00	0.98	-	- 0.07	0.14
[k] $\hat{r}_p$	0.95	0.33	0.94	-	0.05	0.28

[a] $\hat{\sigma}^2_a$ = Additive direct variance estimate; [b] $\hat{\sigma}^2_t$ = permanent environment variance estimate; [c] $\hat{\sigma}^2_e$ = residual variance estimate; [d] $\hat{h}^2$ (E.S.) - heritability coefficient and standard error obtained by one-trait analysis; [e] $\hat{h}^2$ (Average) – average heritability obtained by all of two and three-traits analysis; [f] $\hat{c}^2$ = permanent environment proportion; [g] $\hat{e}^2$ = residual proportion variance; [h] $\hat{t}$ - Repeatability; [i] $\hat{r}_a$, [j] $\hat{r}_t$, [k] $\hat{r}_p$ = genetic, permanent environment and phenotypic correlations between mozzarella cheese yield and other traits; [1]MY270 = accumulated milk yield at 270 days, observed until 305 days of lactation; [2]MY270/A = accumulated milk yield at 270 days, observed until 335 days of lactation; [3]MY305 = accumulated milk yield at 305 days, observed until 335 days of lactation; [4]MCY = mozzarella cheese yield, observed until 335 days of lactation; [5]PP = protein percentage, observed until 335 days of lactation; [6]FP = fat percentage, observed until 335 days of lactation.

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