

## Analysis of phenotypic factors for linear type traits in Holstein cows

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The type traits are important for selection decisions in dairy cattle, because they have direct influence in the traits of economic interest. However, the problem associated with these traits is the large number of traits and the high degree of collinearity and interrelationships between them. Factor analysis is a useful tool to remove redundant information between correlated variables and represents them in a small set called factor. This study aimed to evaluate the phenotypic relationship between linear type traits by means of factor analysis in Holstein cows. A number of 21 type traits were used: stature, top line, chest width, body depth, loin strength, rump angle, rump width, foot angle, bone quality, side view rear legs, fore udder attachment, fore teat placement, teat length, rear udder height, rear udder width, rear teat placement, udder depth, texture and udder cleft, angularity, and the final score that expresses the balance between the type traits. Data records of type traits of 19,678 Holstein cows collected between 1996 and 2008 by ABCBRH<sup>1</sup> technicians were used. In the consistency of the data were excluded cows without pedigree, with a final score less than 60 points, cows with more than one classification, keeping the first one, cows with calving age out of the range of 21-48 months, bulls with less than 10 daughters, and herds with less than 15 cows. Factor analysis was conducted with the FACTOR procedure of SAS<sup>®2</sup>, by the method of maximum likelihood. The partial correlation matrix, a measure of sample adequacy for Kaiser (MSA) with a minimum value of 0.69, and the Bartlett's sphericity test were used to determine the adequacy of the factor analysis. The choice of the factors was based on the amount of eigenvalues greater than one. Orthogonal rotation of factors was performed using the Varimax method, adopting the value of 0.30 as significant. Were excluded from the analysis of factors traits rump angle, side view rear legs, teat length and udder depth, by present value MSA unacceptable ( $MSA < 0.50$ ), and traits foot angle, fore teat placement and rear teat placement, due of the low value of commonality (less than 0.05), remaining 14 traits for further analysis. The low estimates of partial correlation, ranging from -0.19 to 0.38, the average overall MSA (0.79), with individual estimates ranging from 0.69 to 0.88 for body depth for top line and Bartlett's test of sphericity significant ( $p < 0.001$ ), indicating the adequacy of traits for the analysis of factors. It was observed that two factors showed eigenvalues greater than one. The first factor was related to the mammary system, grouping the rear udder height, rear udder width, udder texture, udder cleft, loin strength, bone quality and final score, important traits for udder health and greater productive capacity. The second grouped stature, top line, chest width, body depth, rump width, angularity, fore udder attachment and final score, being named cow structure, conditioning in cows with a well sprung and spacing between the ribs, with the capacity to support its weight, respiratory and digestive system. In general, the commonalities were low ranging from 0.12 (top line) to 0.72 (final score), with emphasis on top line (0.12), lion strength (0.13) and fore udder attachment (0.16) with the lowest values. Factor analysis allowed the identification of two groups of phenotypic traits with higher relation between each other. Studies relating these factors to economic traits should be conducted with the objective of providing support for the indication or not of these factors as indirect predictors of economic traits such as longevity and milk production.

**Keywords:** collinearity, eigenvalue, final score, maximum likelihood, stature, udder texture

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