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Genetic aspects of immunoglobulins G concentration measured with gold standard and predicted from infrared spectra in bovine colostrum

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The concentration of immunoglobulins G (IgG) is the criterion usually adopted to classify the quality of the colostrum administered to calves. Although the reference analysis of IgG (g/L) is time-consuming and expensive, no studies have evaluated the ability of infrared spectroscopy to predict colostrum IgG concentration so far. In this study, colostrum was collected on 693 Holsteins within 6 h after calving following a specific protocol. Samples were analysed through the reference analysis (radial immunodiffusion), which was carried out according to the manufacturer's instructions (Triple J Farm, Bellingham, US) after dilution of colostrum (1:5 v/v) in pure water. Near-infrared spectra (400–2500 nm) were collected on all samples using the DS2500 (Foss, Hillerød, Denmark). After spectra quality editing, the final dataset accounted for 685 samples. The calibration set included 195 samples representative of the 9 herds and cows from parity 1 to 6, and the best prediction model for IgG (RMSE =14.2 g/L; R^2 = 0.84) was reached through 20-fold cross-validation and multiplicative scatter correction and second derivative as mathematical treatment. Finally, IgG was predicted in the validation set which accounted for the remaining 490 samples (RMSE =19.4 g/L; R^2 = 0.73). Variance and covariance components were estimated for both reference and predicted IgG (validation set) using a linear model which included the fixed effects of parity (5 levels: 1, 2, 3, 4, and 5 + 6), the season of calving (4 levels), year of calving (2 levels), and herd (9 levels), and the random effects of additive genetic animal (6714 individuals in the pedigree) and the residual. Means (coefficient of genetic variation) of reference and predicted IgG were 92.4 g/L (14.8%) and 90.5 g/L (15.1%), respectively. Heritabilities of IgG were 0.18 ± 0.15 (reference) and 0.21 ± 0.15 (predicted). The phenotypic correlation between the two traits was positive and strong (0.86 ± 0.01), as well as the genetic correlation (0.99 ± 0.11). Overall, results indicated that IgG can be predicted from colostrum spectra with moderate accuracy and the genetic correlation between the reference and predicted IgG is close to 1. Therefore, IgG predictions can be potentially exploited as phenotypes to improve the IgG content of bovine colostrum, leading to potential practical positive consequences on calf health.

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Genetic modelling of heat stress in Italian Holstein cows

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European Mediterranean countries are characterized by exposure to considerable heat between three and six months annually. The combination of ambient temperature and relative humidity, causes the effective temperature of the environment to be above the thermo-neutral zone of the animals and therefore heat stress occurs. Heat stress is one of the limiting factors in dairy production in hot climates. The interest of our study is to investigate if heat stress results in different effects on Italian Holstein performance due to genetic differences in heat tolerance. Heat stress was modelled by using data from weather stations. Daily maximum temperature and relative humidity were collected from 1994 till now. Weather measurements (777.980 records) were collected from 137 stations distributed across the national territory. Geographical coordinates and altitudes from all weather stations and the community of the farm were available. Distances between weather stations are farms were computed. Milk test day records were linked with the nearest weather stations within 80 km. Weather stations more than 500 m above or below the farm were omitted. Weather estimates for the farm were computed as a weighted average for the geometric center of the chosen weather stations accounting for the distance from the farm. The average distance between the geometric center of the chosen nearby weather stations and the farms was 13.5 km. The aim of this study was to determine if a threshold of the temperature-humidity index (THI) is evident for fat and protein corrected milk (FPCM) in Italian Holstein dairy cows. Because longer periods of heat stress might have a severe effect than shorter periods, 2-, 4-, 5-, 7-, 10- and 14-days were considered using average weather data measurements. For this study, we sampled from the whole Italian population 100 herds with a total of 172748 records belonging to 11150 cows in a period of 17-yr (2003–2020). Fixed regression analyses were based on models that included a herd-year season of recording (HYS), class of dim by parity and THI as a fixed effect. As random effects were considered the cow because there is repeated information per cow, the animal and the residual error. Preliminary results indicate that there is a drop in production in terms of milk energy above 19° of THI index expressed on a Celsius-like a scale in all periods considered. Further study is in progress to estimate the genetic component of heat tolerance.