

COLLECTED TITLES

Editorial: Spreading the word in a post-Caxton era

Christopher H Knight

UK

Comparison of different response variables in genomic prediction using GBLUP and ssGBLUP methods in Iranian Holstein cattle

Mohamadreza Afrazandeh, Rostam Abdolahi Arpanahi, Mokhtar Ali Abbasi, Nasser Emam Jomeh Kashan and Rasoul Vaeze Torshizi

Iran and USA

Abstract

We compared the reliability and bias of genomic evaluation of Holstein bulls for milk, fat, and protein yield with two methods of genomic best linear unbiased prediction (GBLUP) and single-step GBLUP (ssGBLUP). Four response variables of estimated breeding value (EBV), daughter yield deviation (DYD), de-regressed proofs based on Garrick (DRP_{GR}) and VanRaden (DRP_{VR}) were used as dependent variables. The effects of three weighting methods for diagonal elements of the incidence matrix associated with residuals were also explored. The reliability and the absolute deviation from 1 of the regression coefficient of the response variable on genomic prediction (Dev) using GBLUP and ssGBLUP methods were estimated in the validation population. In the ssGBLUP method, the genomic prediction reliability and Dev from un-weighted DRP_{GR} method for milk yield were 0.44 and 0.002, respectively. In the GBLUP method, the corresponding measurements from un-weighted EBV for fat were 0.52 and 0.008, respectively. Moreover, the un-weighted DRP_{GR} performed well in ssGBLUP with fat yield values for reliability and Dev of 0.49 and 0.001, respectively, compared to equivalent protein yield values of 0.38 and 0.056, respectively. In general, the results from ssGBLUP of the un-weighted DRP_{GR} for milk and fat yield and weighted DRP_{GR} for protein yield outperformed other models. The average reliability of genomic predictions for three traits from ssGBLUP was 0.39 which was 0.98% higher than the average reliability from GBLUP. Likewise, the Dev of genomic predictions was lower in ssGBLUP than GBLUP. The average Dev of predictions for three traits from ssGBLUP and GBLUP were 0.110 and 0.144 respectively. In conclusion, genomic prediction using ssGBLUP outperformed GBLUP both in terms of reliability and bias.

Associations among body energy status, feeding duration and activity with respect to diet energy and protein content in housed dairy cows.

Liveness Jessica Banda, Mizeck Gift Gibson Chagunda, Cheryl Joy Ashworth and David John Roberts

UK, Malawi and Germany

Abstract

The study in this research paper was undertaken with a hypothesis that use of accelerometer data can be used to improve monitoring of energy balance in dairy cows. Animals of high (select, S) and average (control, C) genetic-merit lines were allocated to two feeding systems, by-product (BP) and homegrown (HG). This culminated in four production systems referred to as BPS, BPC, HGS and HGC. Cows between their first and fourth lactations were included and a total of 8602 records were used. The target crude protein (CP) and metabolisable energy (ME) content in the BP diet was 185 g/kg DM and 12.3 MJ/kg DM while it was 180 g/kg DM, and 11.5 MJ/kg DM for the HG diet, respectively.

Milk yield, body energy content (BEC) and animal activity were monitored while the animals were all housed for winter. Results showed that cows on homegrown feeds were significantly ($p < 0.05$) more active than cows on by-product feeds as indicated by higher motion index and number of steps per day. Feeding duration was not significantly different ($p > 0.05$) between cows under by-product feeding system irrespective of the energy balance of the cows. However, there were significant differences for cows under homegrown feeding system. Cows in negative energy balance had a longer feeding duration per day than cows in positive energy balance. Milk yield was negatively correlated ($p < 0.05$) to motion index and number of steps per day but not to lying time and feeding duration. The results showed differences in cow activity were related to diet content and body energy status. This is useful in precision farming where feeds are provided according to specific animal behaviour and feed requirements.

Effect of replacing soybean meal by a blend of ground corn and urea-ammonium sulphate on milk production and composition, digestibility and N balance of dairy Murrah buffaloes

Tobias Tobit Melo, Leilson Bezerra, Viviany Santos, Marcelo Ferreira, Valdi Lima Junior, Luana Andressa Silva, Migson Menezes, Francisco Silva Filho and Ronaldo Oliveira

Brazil

Abstract

This study evaluated the effect of replacing soybean meal by a blend of ground corn and urea-ammonium sulphate (GCU-S) in the diet of lactating buffaloes on milk production and composition, digestibility, N balance and blood metabolites. Twelve multiparous dairy Murrah buffaloes (*Bubalus bubalis*), at 100 ± 4 days in milk and yielding 10 ± 2.5 kg/d, were randomly distributed in a triple 4×4 Latin square, with four different inclusions of GCU-S at U-S levels: 0 (control), 8.0, 16.4 and 24.1 g/kg dry matter (DM) total. Replacing soybean meal with GC-US had a significant depressing effect on absolute DM intake, which was still numerically evident but no longer significant when expressed on a body weight-related basis. Intakes of crude protein (CP) and N as well as N-urinary excretion were also significantly depressed. Digestibility of dry matter was improved and, as a proportion of DMI, intake of total digestible nutrients increased significantly. Perhaps as a result, feed efficiency (kg DMI required per kg 6% fat-corrected milk) was significantly improved. Efficiency of protein use for milk production was significantly improved, but not when expressed as milk protein output. N transfer into milk, as a proportion of total N intake, also increased significantly. However, GC-US inclusion had no significant effect on milk production or milk composition, nor did it affect serum metabolites, digestibilities (apart from dry matter) or N measures of balance apart from those mentioned above. Inclusion of this blend of ground corn with urea and ammonium sulphate can be recommended for dairy buffalo because, although it decreases DMI and N-excretion, it improves DM digestibility and feeding efficiency whilst maintaining milk production and composition.

Economic losses in dairy farms due to heat stress in sub-tropics: evidence from North Indian Plains

Bishwa Bhaskar Choudhary and Smita Sirohi

India

Abstract

The present study assesses the sensitivity of dairy animals to thermal stress, and projects the economic losses due to heat stress in the Trans and Upper Gangetic plains region of India with Representative Concentration Pathway (RCP) 4.5 climate scenario for the time slice 2010–2039 and two subperiods, 2020–2029 and 2030–2039. The projections were carried out for two different

scenarios of population and productivity growth of dairy animals, Business-as-Usual (BAU) and Alternate, whereby land, feed and fodder constraints were applied. The potential annual loss in milk production due to heat stress in the region was estimated to be around 361 and 377 thousand tons for the time slice 2010-39 under BAU and Alternate scenario, respectively. In economic terms these losses, at current prices, would be equivalent to INR 11.93 billion and INR 12.44 billion, respectively. This gives an indication of the level of financial investment that can be made in adaptation measures to arrest the loss due to climate change.

Modelling growth in dairy heifers based on linear body measurements (withers height) using non-linear functions

Hassan Darmani Kuhi, Navid Ghavi Hossein-Zadeh, James France and Secundino López

Iran, Canada and Spain

Abstract

This research communication reports a study to model the growth curves for withers height (WH) and body weight (BW) to withers height ratio (BW:WH) using monthly records (from 1 to 24 mo of age) for three breeds of dairy heifer (Holstein, Jersey and Brown Swiss). The data sets used were those reported by the Dairy Heifer Evaluation Project of Penn State Extension (USA) between 1991 and 1992. Four growth functions (monomolecular and Michaelis-Menten, both with diminishing returns behaviour, and Schumacher and Lopez, both with asymptotic sigmoidal behaviour) were fitted using the non-linear regression procedure of the SigmaPlot software and the parameters estimated. The models were judged for goodness of fit using adjusted coefficient of determination (R_{adj}^2), root mean square error (RMSE), Akaike's information criterion (AIC) and Bayesian information criterion (BIC). Assessing the goodness of fit by (R_{adj}^2) (> 0.99 in all cases) reveals the generally appropriate fit of the models to the data. The non-sigmoidal functions (i.e. Michaelis-Menten and monomolecular) provided the best fits giving the lowest values of RMSE, AIC and BIC. Based on the chosen statistical criteria, the Schumacher and Lopez equations provided acceptable fits to the WH and BW:WH growth curves, but showed points of inflexion at times before birth, indicating that these growth curves are not sigmoidal. In conclusion, evaluation of the different non-linear growth functions used in this study indicated their potential for modelling growth patterns in dairy heifers.

Housing assessment in farms in the Northwest of Spain: main facility weaknesses and strengths

Sonia Verdes, Uxía Yáñez, Yolanda Trillo, Pedro G. Herradón, Ana I. Peña, Juan J. Becerra and Luis A. Quintela

Spain

Abstract

The aim of this research communication was to examine and report the current situation of dairy farms in the province of Lugo (Galicia, Spain) regarding facility problems. We assessed the facilities of 168 free-stall dairy farms, housing in total 9228 Holstein cows in milk. Housing factors related to the resting area, circulation area, feeding area, ventilation area and milking area, as well as animal-handling features, were evaluated. Distance measurements were performed using a laser metre or a roll metric tape. A survey was conducted to gather information about cleaning and preventive protocols. Our results showed that most farms do not comply with the objective for cubicle measurements, width of the crossovers, type of flooring and presence of a quarantine pen, which may have a negative impact on the health and productivity of the animals. Therefore, to maximise

the profits of the farm, the recommendations given in this study may be useful as a guide when building a new farm or remodelling the existing ones.

Estradiol administration in Holstein heifer calves differentially affects the fatty acid composition of subcutaneous adipose and the mammary fat pad tissues

Marina Miquilini, Nicole R. Hardy, Phyllis A. Dieter, Alejandro E. Relling and Benjamin D. Enger

USA

Abstract

This research communication reports the relative abundance of fatty acids in mammary fat pad (MFP) and subcutaneous adipose (SCA) tissues for Holstein heifer calves receiving 0, 3, or 12 daily injections of estradiol immediately prior to tissue collection. The objective of this study was to determine if the MFP and SCA fatty acid profiles were affected by estradiol administration and if such a response differs between adipose tissue depots. Twelve Holstein heifer calves were reared on a common diet and administered 12 daily injections prior to euthanasia. Injections were either daily injections of corn oil (n = 4; CON), 9 injections of corn oil followed by 3 injections of estradiol (n = 4; SHORT), or 12 injections of estradiol (n = 4; LONG). Fatty acids were extracted from collected MFP and SCA tissues samples and analyzed using gas chromatography. The MFP tissues contained a greater abundance of saturated fatty acids than SCA tissues which complemented a reduced abundance of mono-unsaturated fatty acids in the MFP than SCA. Extended duration of estradiol administration increased the abundance of total omega 3 fatty acids in both MFP and SCA tissues. There was a treatment by tissue interaction for several of the C18:1 and C18:2 isomers indicating that estradiol's effects on fatty acid uptake and metabolism are tissue specific. Additionally, C18 uptake and metabolisms may have important roles in mammary growth and development. Together, these results indicate that the MFP responds differently to estradiol administration than SCA tissues and that these alterations are associated with different degrees of induced mammary growth via estradiol.

The relationship between dry period length and milk production of Holstein dairy cows in tropical climate: A machine learning approach

Gabriel M. Dallago, Juscilene Aparecida Silva Pacheco, Roseli Aparecida dos Santos, Gustavo Henrique de Frias Castro, Lucas Lima Verardo, Leonardo Rabello Guarino and Eduardo Uba Moreira

Canada and Brazil

Abstract

The objective of this retrospective longitudinal study was to evaluate the relationship between dry period length and the production of milk, fat, protein, lactose and total milk solids in the subsequent lactation of Holstein dairy cows under tropical climate. After handling and cleaning of the data provided by the Holstein Cattle Breeders Association of Minas Gerais, data from 32,867 complete lactations of 19,535 Holstein animals that calved between 1993 and 2017 in 122 dairy herds located in Minas Gerais state (Brazil) were analysed. In addition to dry period length, calving age, lactation length, milking frequency, parity, calf status at birth, herd, year, and season of calving were included in the analysis as covariables to account for additional sources of variation. The machine learning algorithms gradient boosting machine, extreme gradient boosting machine, random forest and artificial neural network were used to train models using cross validation. The best model was selected based on four error metrics and used to evaluate the variable importance, the interaction strength between dry period length and the other variables, and to generate partial dependency

plots. Random forest was the best model for all production outcomes evaluated. Dry period length was the third most important variable in predicting milk production and its components. No strong interactions were observed between the dry period and the other evaluated variables. The highest milk and lactose productions were observed with a 50-day long dry period, while fat, protein, and total milk solids were the highest with dry period lengths of 38, 38, and 44 days, respectively. Overall, dry period length is associated with the production of milk and its components in the subsequent lactation of Holstein cows under tropical climatic conditions, but the optimum length depends on the production outcome.

Successful lactation in *Plgrkt*-deficient female mice caused by a 1-bp deletion of exon4

Takayuki Iwaki, Yuki Tomonari and Kazuo Umemura

Japan

Abstract

Plasminogen (Pg) activation on the cell surface is important for various (patho)physiologic conditions, and Plg-R_{KT} is a cell membrane protein that binds to Pg and promotes its activation. To evaluate the role of Plg-R_{KT} in atherosclerosis, *Plgrkt* gene in *Ldlr*^{-/-}/*Apobec1*^{-/-} was modified using *in vivo* CRISPR/Cas9. Synthetic RNA for *Plgrkt* and Cas9 complex was electroporated into the fertilized eggs in the oviducts. *Plgrkt* deficient mice were established through a 1-bp deletion, and in this research communication we report their lactational ability. In contrast to *Plgrkt*^{-/-} mice developed by a conventional method, these newly developed mice did not suffer lactation failure and could maintain their pups until weaning. The major obvious difference between these lines is the area of gene modification. The conventionally developed mouse possesses about 10 kb deletion of *Plgrkt*, which might relate to the lactation failure. Lactation failure is a lethal phenotype in mammals, and analyses of causative genes are especially important for dairy industries. Further genome-wide analyses with both *Plgrkt*^{-/-} mice may help to establish causative genes for lactation failure.

A retrospective on claims regarding clinical mastitis in the subsequent lactation, after use of an internal teat sealant in the dry period.

J Eric Hillerton and Elizabeth A Berry

New Zealand and UK

Abstract

Infusion of an internal teat sealer into the mammary gland of the dairy cow at drying off has been claimed to reduce the incidence of clinical mastitis for many months in the subsequent lactation, despite the absence of any ingredient of the sealant remaining for that long. However, these claims have been poorly substantiated, often by lack of identification on when the infection occurred in the period from calving to disease, if the infection was present at post calving sampling and if the pathogen causing the disease was that causing an earlier infection. Moreover, no hypothesis on how any effect on clinical mastitis might occur has been advanced in any of the publications claiming the effect. That the effect might occur is only reported in a minority of publications, and the possibility that this is relatively specific to Gram-negative pathogens is reviewed.

Streptococcus agalactiae induced autophagy of bovine mammary epithelial cell via PI3K/AKT/mTOR pathway

Mengzhu Qi, Hao Geng, Na Geng, Yukun Cui, Changxi Qi, Guodong Cheng, Kaimin Song, Liping Hu, Yongxia Liu, Jianzhu Liu and Bo Han

China

Abstract

Streptococcus agalactiae (*S. agalactiae*) infection is a significant cause of mastitis, resulting in loss of cellular homeostasis and tissue damage. Autophagy plays an essential function in cell survival, defense, and the preservation of cellular homeostasis, and is often part of the response to pathogenic challenge. However, the effect of autophagy induced by *S. agalactiae* in bovine mammary epithelial cells (bMECs) is mainly unknown. So in this study, an intracellular *S. agalactiae* infection model was established. Through evaluating the autophagy-related indicators, we observed that after *S. agalactiae* infection, a significant quantity of lc3-I was converted to lc3-II, p62 was degraded, and levels of Beclin1 and Bcl2 increased significantly in bMECs, indicating that *S. agalactiae* induced autophagy. The increase in levels of LAMP2 and LysoTracker Deep Red fluorescent spots indicated that lysosomes had participated in the degradation of autophagic contents. After autophagy was activated by rapamycin (Rapa), the amount of p-Akt and p-mTOR decreased significantly, whilst the amount of intracellular *S. agalactiae* increased significantly. Whereas the autophagy was inhibited by 3-methyladenine (3MA), the number of intracellular pathogens decreased. In conclusion, the results demonstrated that *S. agalactiae* could induce autophagy through PI3K/Akt/mTOR pathway and utilize autophagy to survive in bMECs.

Modification of milk resulting in low potassium and minimal electrolyte changes with minimal changes in taste

Kazuhiro Hara

Japan

Abstract

The objective of this research communication was to produce low potassium milk in which other electrolyte changes and changes in taste were minimized. To reduce potassium concentrations, several studies have reported batch methods of directly mixing milk or formula with sodium polystyrene sulfonate, which can exchange cations such as potassium for sodium. However, they also reported increases in sodium content, decreases in calcium and magnesium content, and changes in taste, because sodium polystyrene sulfonate exchanged other substances such as calcium and magnesium for sodium. In the present study, a method of dialyzing whole cow's milk using both sodium polystyrene sulfonate and a small amount of water through cellophane membranes was developed. A batch method for comparison was also performed. Each milk sample was evaluated biochemically and analyzed for taste and aroma in a sensory analysis. We showed that the potassium concentration in the dialyzed milk was reduced to 38% of that in unreacted milk. It was also shown that changes in sodium (increased) as well as calcium and magnesium (decreased) in the dialyzed milk were less than half of those in the batch method milk. Sensory analysis showed that minimal changes occurred in the taste of the dialyzed milk.

Use of batch anion exchange technique for separation of κ -casein glycomacropeptide from bovine whey fraction

Takuo Nakano and Mirko Betti

Canada

Abstract

Bovine κ -casein glycomacropeptide (GMP) is a sialic acid containing glycopeptide, which is considered as a health promoting compound found in cheese whey. The study described in this research communication was undertaken to determine whether GMP with undetectable level of contaminating protein or phenylalanine can be isolated from bovine whey fraction using batch anion exchange technique with chitin as an adsorbent. A soluble whey fraction (SWF) prepared from 1 g whey protein isolate (WPI) was mixed with a slurry of 1 g chitin, and the mixture was incubated at pH 3.0. After incubation, the mixture was filtered, and the residue obtained (containing chitin-GMP complex) was washed with water and eluted stepwise with 0.5 M NaCl and 2.0 M NaCl. Most of GMP (corresponding to 75.8% of total sialic acid recovered) was eluted with 0.5 M NaCl. The recovered GMP accounted for 5.4% dry weight of WPI (or 18.9% dry weight of SWF). Amino acid analysis showed that there was no detectable level of contaminating amino acids including phenylalanine, histidine, arginine and tyrosine in the GMP fraction. It was concluded that the batch anion exchange method with chitin developed in this study can be used for the isolation of high purity GMP from bovine SWF.

Measurement of water-holding capacity in fermented milk using near infrared spectroscopy combined with chemometric methods

Pernille Uma Havmand, Lau Gustav Zachariassen, Richard Ipsen and Vera Kuzina Poulsen

Denmark

Abstract

We investigated the use of near-infrared spectroscopy (NIR) for measuring water-holding capacity (WHC) in fermented milk. Increased WHC ensures improved texture and decreased syneresis in fermented dairy products and also improves cheese yield. NIR combined with partial least squares-discriminant analysis (PLS-DA) was found to be a promising rapid and non-invasive method with no pretreatment of the samples for prediction of WHC in fermented milk samples. Analysis of the chemical bonds in the region $10700\text{-}4500\text{ cm}^{-1}$ ($935\text{-}2200\text{ nm}$) of the electromagnetic spectrum was able to distinguish between samples with high vs. low WHC. This technique was successfully used to screen different strains of lactic acid bacteria for their ability to provide fermented milk with increased WHC, which is of great importance for use in various dairy products.

Citric acid incorporated in a chitosan film as an active packaging material to improve the quality and duration of matured cheese shelf life

Jéssica Barrionuevo Ressutte, Tascila Ferreira Saranti, Márcia Regina de Moura, Magali Soares dos Santos Pozza, Mônica Regina da Silva Scapim, Ana Paula Stafussa and Grasielle Scaramal Madrona

Brazil

Abstract

Chitosan-based film incorporated with citric acid was prepared by the casting method for application in a Brazilian matured cheese. Three formulations of cheese were processed, with the intention of evaluating the application of a starter culture and the effect of the film in terms of its physiochemical, microbiological, and sensorial characteristics. It was observed by scanning electron

microscopy (SEM) analysis that the film has a homogeneous appearance, and the crosslinking between citric acid and chitosan was confirmed by the Fourier transform infrared spectroscopy (FTIR) analysis. The cheese with chitosan-based film presented lower weight loss (5.2%) and showed antimicrobial activity against aerobic mesophilic bacteria. All samples showed high rates of sensorial acceptability (>79%), with no significant differences between them. It is apparent that the chitosan film maintained the typical cheese characteristics. Therefore, chitosan and citric acid film can be used to improve the characteristics of matured cheese and extend its shelf life.

Authenticity under threat: grated Parmesan cheese sold in Brazil

Rafael Fagnani, Bruno Cesar Michelette Damiao, Régia Patrícia Saviani Trentin and Ana Paula Kuller Zanoni

Brazil

Abstract

This research communication depicts the quality and authenticity of grated Parmesan cheese sold in Brazil, with novel emphasis on ripening time. The sampling included all brands manufactured and packed at Brazilian dairy plants under federal inspection and sold in Londrina between June and September 2017. A total of 24 samples were analyzed (3 batches of 8 brands) for microbiological and compositional characteristics, including urea-PAGE electrophoresis for the quantitative determination of the milk proteins. About 80% of the samples were insufficiently ripened and 32% with low-fat content. Faced with these economically motivated food frauds, the authenticity of grated Parmesan in Brazil may be under threat. It is high recommended that future surveys and regulatory agencies go further than microbiological assessment, including and emphasizing the ripening time as the main parameter of grated Parmesan cheese.

A review of factors influencing the quality and sensory evaluation techniques applied to Greek yogurt

Rabin Gyawali, Xi Feng, Yan Ping Chen, Jose M. Lorenzo and Salam Ibrahim

USA, China and Spain

Abstract

Greek yogurt is one of the fastest growing products in the dairy industry. It is also known as strained yogurt, which is obtained after draining the whey. As a result of the draining process, Greek yogurt has higher total solids and lower lactose than regular yogurt. Since it is a concentrated yogurt, its sensory characteristics are different from regular yogurt. However, there is little information about factors influencing the quality of Greek yogurt and sensory evaluation techniques applied to Greek yogurt. This review aims to describe the effects of ingredients, starter cultures, processing techniques and other parameters on quality characteristics and sensory properties of Greek yogurt. In addition, advantages and limitations of novel sensory evaluation techniques applied to Greek yogurt products are discussed. In particular, we take a look at advanced techniques such as the electronic nose and electronic tongue and the benefits of these techniques with regard to Greek yogurt. This review should help the Greek yogurt industry to improve its current products and develop innovative products based on appropriate food evaluation techniques.