ABSTRACTS
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6th Joint EAAP/ASAS Workshop on Biology of Lactation in Farm Animals
Alternative Strategies in Dairy Cow Management

1 Sensors and management support in high-tech milking. H. Hogeveen*[1] and W. Ouweltjes[2], [1]*Farm Management Group, Wageningen University, the Netherlands,* [2]*Research Institute for Animal Husbandry, Lelystad, the Netherlands.*

Two trends can be distinguished in the application of milking technologies on dairy farms: 1. High capacity (in terms of milkings per person per hour) milking parlors and 2. Automatic milking (AM) systems. In both types of systems the available labor must be directed to those cows that need it: management by exception. Therefore, sensors will be useful and necessary in AM systems. Since the 1980's, work has been carried out on the development and application of in-line sensors. Most work was concentrated on electrical conductivity, which is currently still the most applied technique for mastitis detection in AM systems. However, sensor development was technique-driven. A demand-driven approach will be better and the following questions need to be answered before further development of sensors: Which information is necessary to optimize the basic process of milking, and what information is necessary to support the decision making process around milking, e.g. detection of clinical mastitis. Because of the increased societal interest in animal health and welfare, these questions have to be answered within the constraints that milk must be a safe product, produced by healthy, well-managed animals in a hygienic and animal-friendly environment. Besides the need for more management information, application of high-tech milking changes milking procedures. In large capacity milking parlors, there is not more than 10 sec. time for udder preparation. Data show that in AM systems compared to conventional milking, the udder preparation process takes much more time and is very consistent. However, the time for teat cup attachment in AM systems is relatively long and very variable. Moreover, because of attachment failures, the milk let down is also influenced. Although available data to date provide some information, the full short and long term consequences of the indicated changes in milking procedures on milk production are not fully known.

Key Words: Milking systems, Milk production, Sensors

2 Effects of once-a-day vs twice-a-day milking throughout lactation in dairy goats. A.A.K. Salama, X. Such, G. Caja*, M. Rovai, R. Casals, E. Albanell, and A. Marti, *Universitat Autonoma de Barcelona, Bellaterra, Spain.*

The effects of once (**1x**) vs twice (**2x**) daily milking on milk yield, milk composition and udder health were studied in dairy goats throughout lactation. For two consecutive years, a total of 32 Murciano-Granadina dairy goats were assigned at wk 2 of lactation to two treatment groups, and were either milked 1x (0900; n= 17) or 2x (0900 and 1700; n= 15) daily until wk 28 of lactation. Goats were dried off at 300 DIM. Milk yield was recorded weekly, and milk composition, somatic cell count (SCC) and bacterial intramammary infections were evaluated for individual udder halves of each goat at each milking at wks 2 and 4 of lactation and then, monthly until the end of the experiment. Once-a-day milking resulted in 18% reduction in the yield of energy corrected milk at 4% fat (FCM-4%) compared to 2x (1.6 vs 2.0 L/d; $P<0.001$). This reduction was more marked from wk 2 to 12 (19%; $P<0.05$) than in late lactation (14%; $P<0.08$). Response to milking frequency varied according to goat's parity number ($P<0.01$): $\leq$2nd parity (1.5 vs 2.4 L/d; $P<0.01$), 3rd parity (1.4 vs 1.8 L/d; $P<0.05$) and $\geq$4th parity (1.7 vs 1.9 L/d; $P= 0.284$) for 1x vs 2x, respectively. Milk of 1x goats contained more ($P<0.05$) total solids (13.6 vs. 12.9%), fat (5.4 vs. 4.6%) and casein (2.6 vs. 2.4%) than milk of 2x goats. However, yields of total solids, fat, protein and casein tended ($P<0.10$) to be higher for 2x than 1x. Udder health was not modified by the experimental treatments but one goat from each treatment suffered mastitis and their data were excluded from the analysis. Geometric mean of milk SCC did not differ between treatments (979 vs 917×10^3 cells/ml; $P= 0.189$) for 1x vs 2x, respectively. Total FCM-4% milk yield on 300 DIM was also lower for 1x vs 2x (504 vs 590 L; $P<0.01$) goats, respectively. We conclude that application of once-a-day milking in Murciano-Granadina dairy goats reduced moderately milk yield but did not have negative effects on milk composition and udder health. An increase in labor productivity is also expected.

Key Words: Once-daily Milking, Milk Composition, Somatic Cell Count

3 Management of photoperiod in the dairy herd for improved production and health. Geoffrey Dahl*[1] and Denis Petitclerc[2], [1]*University of Illinois,* [2]*AAFC-Dairy and Swine R&D Centre.*

Environmental influences on lactation efficiency are frequently associated with reductions in milk output. Heat stress, for example, leads to depressed feed intake and subsequently losses in production. Conversely, cold stress may limit nutrients available for milk synthesis. Fortunately, one environmental factor, photoperiod, can exert a positive effect on dairy performance when managed properly. Long days have consistently been shown to improve milk yield during established lactation. In addition, photoperiod management can be used to improve heifer growth and maximize accretion of lean tissue including mammary parenchyma. There is, however, evidence of refractoriness to long day stimulation. Recent work has focused on the dry period as a time when photoperiod manipulation can influence subsequent milk production. In contrast to lactating cows, multiparous cows benefit from exposure to short days when the dry period is followed by long days or ambient photoperiod after calving. Similarly, primiparous animals also respond positively to short days late in pregnancy when subsequently exposed to long days during lactation. Emerging evidence suggests that short days positively influence immune function in cattle. Mechanistically, it appears that prolactin has a causal relationship with the observed dairy performance effects during the dry period and on immune function, via altered sensitivity to prolactin through differential expression of prolactin receptor in multiple tissues. The objectives of this paper include a review of fundamental aspects of photoperiod physiology, integration of applied and basic research findings, and development of management recommendations for the entire life cycle of the dairy cow to optimize performance.

Key Words: Photoperiod, management, immune function

4 Effects of chronic oxytocin administration on oxytocin release and milk ejection efficiency. J. Macuhova[1], V. Tancin[1,2], and R. M. Bruckmaier[1], [1]*Institute of Physiology, Techn. Univ. Munich-Weihenstephan, Freising, Germany,* [2]*Research Institute of Animal Production, Nitra, Slovakia.*

The objective of this study was to test if reduced release of oxytocin (OT) from the pituitary or the sensitivity of OT receptors in the mammary gland are responsible for the reduced spontaneous milk ejection after long-term OT treatment. Fourteen healthy Brown Swiss dairy cows were used for the experiment. Cows were routinely milked twice daily at 5 a.m. and 4 p.m. in a 2x2 tandem milking parlour. They were randomly assigned to two treatment groups, seven animals in each group. During a period of 19 d they were i.m. injected with 5 ml NaCl solution (NaCl group) or 5 ml (50 IU) OT (OT group) 1 min before start of each milking. During evening milkings before and after chronic NaCl or OT treatment blood samples were collected at 1-min intervals for analysis of OT blood concentrations. At the end of these milkings OT (10 IU) was i.v. injected to remove residual milk. To detect changes in mammary gland sensitivity to OT, intramammary pressure (IMP) in the udder cistern was recorded during OT infusion before and after the chronic NaCl and OT treatment period. OT was infused at 0.15 IU/min, which caused a steady increase of OT blood concentration. The occurrence of milk ejection was visualized by an IMP rise in the cistern. Chronic NaCl treatment did not influence milk removal, OT release or IMP pattern. Chronic OT treatment reduced spontaneous milk removal by 15±5 %. OT release during milking was not reduced after chronic OT treatment. During OT infusion and IMP recording, commencement of milk ejection was similar before and after chronic OT treatment. However, time to reach IMP maximum was prolonged after chronic OT treatment ($p<0.05$). In conclusion, chronic OT administration did not change OT release nor OT blood concentration required to commence myoepithelial contraction. However, the intensity of myoepithelial contraction was reduced thus causing incomplete udder emptying.

Key Words: Oxytocin Treatment, Milk Ejection, Cow

5 Lactation persistency: insights from mammary cell proliferation studies. A.V. Capuco*[1], S.E. Ellis[2], S.A. Hale[3], E. Long[1], R.A. Erdman[3], X. Zhao[4], and M.J. Paape[1], [1]*USDA-ARS, Beltsville, MD,* [2]*Clemson University, Clemson, SC,* [3]*University of Maryland, College Park,* [4]*McGill University, Quebec, Canada.*

Milk yield is a function of the secretory activity and number of mammary epithelial cells. A persistent lactation is dependent upon maintaining number and activity of milk secreting cells with advancing lactation. When dairy cows are milked twice daily, the increase in milk yield from parturition to peak lactation is due to increased secretory activity per cell, rather than to accretion of additional epithelial cells. After peak lactation, declining milk yield is due to loss of mammary epithelial cells by apoptosis. During lactation, only 0.3% of mammary cells proliferate in a 24-h period. Yet this proliferative rate is sufficient to replace most mammary epithelial cells by the end of lactation. Management practices can influence lactation persistency. Administration of bovine somatotropin may enhance persistency by increasing cell proliferation and turnover, or by reducing the rate of apoptosis. Increased milking frequency during the first weeks of lactation increases milk yield even after return to less frequent milking, with increases of ∼10% over the entire lactation. A proliferative response to frequent milking during early lactation appears to be involved. Conversely, advanced pregnancy, infrequent milking, and mastitis increase death of epithelial cells by apoptosis. Regulation of mammary cell renewal provides a key to increasing persistency. Investigations to characterize epithelial cells that serve as the proliferative population in the bovine mammary gland have been initiated. Epithelial cells that stain lightly in histological sections are evident through all phases of mammary development and secretion, and account for nearly all proliferation in the prepubertal gland. Characterization of these cells may provide a means to regulate mammary cell proliferation and thus to enhance persistency, reduce the effects of mastitis, and decrease the necessity for a dry period.

6th Joint EAAP/ASAS Workshop on Biology of Lactation in Farm Animals
Lactation Biology in the Post-Genomic Era

6 Transgenic livestock: promise fulfilled. M.B. Wheeler*, *University of Illinois at Urbana-Champaign.*

Over the past two decades the ability to alter the genome of animals, by the introduction of DNA, has been a major technological advance in agriculture. Transgenic animals are produced by the introduction of a small, isolated, known fragment of DNA into pre-implantation embryos. This DNA is inserted into the chromosomes of the embryo and is expressed in all tissues of the resulting individual. The ability to move genes into organisms has been referred to as "gene transfer". This technique is of great importance to many aspects of biomedical science and agriculture. There are numerous potential applications of transgenic methodology to develop new or altered strains of agriculturally important livestock. Practical applications of transgenics in livestock production include improved milk production and composition, increased growth rate, improved feed utilization, improved carcass composition, increased disease resistance, enhanced reproductive performance, and increased prolificacy. The improvement of the nutrient or therapeutic value of milk may have a profound impact on survival and growth of newborns in both humans and animals. Transgenic pigs containing gene constructs (for the bovine milk protein alpha-lactalbumin) designed to improve sow milk have been produced. Results of these studies have shown the concentration of bovine alpha-lactalbumin was directly correlated with the concentration of endogenous porcine milk proteins throughout the 21 days of lactation. Milk production was higher in transgenic sows on days 3, 6 and 9 of lactation as compared to control sows. At weaning (d 21), piglets suckling the transgenic sows weighed 0.5 kg more than piglets suckling control sows. The use of transgenics to improve lactation can enhance offspring growth and may enhance offspring health in economically valuable livestock. The ultimate utility and value of transgenic technology will be limited by our ability to identify genes and appropriate regulatory sequences for the production of traits we wish to improve. Future improvements in nuclear transfer (cloning) technology, automation of embryo handling techniques and improvements in gene and/or chromosome transfer technology will in-