656 Lipases and lipolysis in milk and dairy products. H. C. Deeth*, *School of Land, Crop and Food Sciences, University of Queensland, Brisbane, Queensland, Australia*.

The enzyme, lipase, which catalyses the hydrolysis of triglycerides to free fatty acids, partial glycerides and, in some cases, glycerol, is a constant concern in the dairy industry. It presents in different forms but chiefly as the indigenous milk lipoprotein lipase and a raft of lipases produced by contaminating microorganisms in milk and dairy products. Lipases can cause flavour problems as well as texture problems such as inhibition of foaming of milk used for making cappuccino coffee. However, not all lipases are detrimental to the quality of dairy products. For example, they play a very important role in the typical flavour of many cheeses. While much is now known about the nature of these enzymes and their action in milk and dairy products, lipase-related problems continually arise. This paper discusses some case studies where lipase has been involved and outlines the causes and solutions to the problems in the light of this knowledge.

Key Words: lipase, lipolysis, dairy industry

657 Native proteases in milk: Current knowledge and relevance to dairy industry. B. Ismail*[1] and S. Nielsen[2], [1]*University of Minnesota, St. Paul*, [2]*Purdue University, West Lafayette, IN*.

Plasmin is by far the predominant and most completely studied endogenous protease in bovine milk, so will be the primary focus of this talk on native proteases in milk. The hydrolysis of milk proteins by proteases, such as plasmin, affects the texture and flavor of dairy products, to have either beneficial or detrimental effects, depending on the extent of hydrolysis and type of dairy product. Plasmin is part of a complex protease-protease inhibitor system in milk that consists of active (plasmin) and inactive (plasminogen) forms of the enzyme, activators, and inhibitors. Considerable research has been done to isolate and characterize components of the plasmin system, determine how they interact, assess thermal stability, and develop and compare quantitation methods. Additionally, several studies have been carried out on the plasmin system activity and interactions as affected by cow characteristics, milk storage, processing conditions, bacterial proteases, and various milk proteins such as β-lactoglobuling and κ-casein. Depending on the end use, researchers have focused on either enhancing or minimizing the activity of plasmin system components. The intent has been to control protease activity in casein and whey fractions, depending on the food or ingredient application. Controlling the activity of endogenous milk proteases, such as plasmin, has great potential to improve dairy product quality and reduce their processing costs.

Key Words: milk proteases, plasmin, endogenous enzymes

Extension Education: Symposium: Models for Dairy Production Decision Making

658 To keep or cull a cow: An economic decision. A. De Vries*, *University of Florida, Gainesville*.

Dairy cow culling decisions are economic decisions. When a cow is culled, the producer expects to be better off without the cow. When no replacement is available, the open cow is often kept as long as her milk income exceeds her variable cost. When replacements are available, the typical recommendation is to keep the slot full, meaning that the culled cow should be immediately replaced by another cow, often a calving heifer. Alternatively, calving heifers may accelerate cow culling when space is limited. The decision to keep the current cow as long as her milk income exceeds her variable cost is then no longer optimal because earlier replacement might improve the profitability of the slot. When groups are overcrowded, culling might improve the performance of the remaining cows. In many of these situations, cash flow projections of the keep and cull decision may support the quality of decision making. Accurate cash flow projections are difficult to make without the help of computers and modeling. This difficulty arises because cash flow projections involve sequential cows in the same stall with differences in milk production, stage of lactation, and reproductive status, among others. Further, decisions in the future may or may not be optimized. Algorithms have been designed that provide cash flow projections of both the keep and cull decision for individual cows. Differences of the net present values of such projections allow for ranking of cows for future profitability, and hence identification of cows recommended for culling. Such algorithms have not been widely used on dairy farms because they were either not available, there was a lack of understanding of the calculations, or producers did not see the need for decision support. Newer algorithms allow for more accurate cash flow predictions based on daily updated cow performance data. They also allow for more insight in the calculations. Further, multiple decisions may be optimized simultaneously, such as insemination decisions, dry-off decisions, and replacement decisions. Collectively they provide added value to increasing amounts of data that is becoming available at a more rapid pace.

Key Words: culling, model, economics

659 Modeling the economic impact of reproductive change. M. W. Overton*, *University of Georgia, Athens*.

A spreadsheet-based model using partial budgeting was used to develop a stochastic simulation approach to estimate the economic benefit of improved reproductive performance in U.S. dairy herds. Through simulation, a herd is calved and followed through lactation. Time dependent culling risks and pregnancy rates for each cycle were used to project cumulative pregnancy rates following twelve potential breeding cycles. Distributions were fit to describe the potential cycle-specific conception and insemination risks and overall 305-day ME milk production for Holstein cows. Farm-level prices for milk, calves, market cows, and replacement animals from January 2007 through February 2009 were used to fit distributions for predicting future returns. Values associated with changes in pregnancy rate were obtained by comparison of a simulated reproductive management program with a simple estrus detection-based AI program. Final results were obtained by running 1000 iterations through the use of simulation software and are displayed as probability distributions, with a mean expected value and a 90% expected range. Sources of revenue include annualized milk per cow per day, annualized values of calves produced, and the annualized value of the market cows. Expenses include annualized replacement costs, the marginal feed consumed by cows producing marginal milk, feed consumed by additional non-lactating cows, additional costs for

housing, labor or medical expenses, and extra costs associated with the change in reproductive management. The estimated value derived from improving pregnancy rate from 10% to 32% is nonlinear, with the largest returns resulting from improvements to very low pregnancy rates. The relative value of improving pregnancy rate by one unit between 10% and 20% is more than six times higher than the value of a unit change, on average, between 22% and 32% pregnancy rate. Sensitivity analysis revealed that net returns per lactating cow slot per year were influenced by milk price, herd milk production level, feed cost, replacement cost, and heifer calf value, in decreasing order of magnitude.

Key Words: reproduction, economic model, stochastic simulation

660 Modeling nutrition decisions. M. D. Hanigan*, *Virginia Polytechnic Institute and State University*, *Blacksburg*.

Feed costs represent approximately half of the operating costs of a dairy. Because feed supplies the nutrients needed by animals to maintain themselves, grow, reproduce, and produce milk, it is critical to provide enough nutrients to achieve production goals. However, feeding excess nutrients has negative economic and environmental implications. Mathematical models of nutrient availability and animal requirements are used to make feeding decisions. The accuracy and precision of the feeding decisions are subject to the accuracy and precision of the models used to construct them as well as the input descriptors. The latest version of the NRC model appears to have greater precision than previous versions of that model, particularly for energy and metabolizable protein. The precision of the Cornell model also has improved over time although it does not appear to be as precise as the NRC model. Additional refinement of equations describing amino acid supply and requirements is required to maximize productivity and efficiency. Stochastic tools have been developed that allow consideration of variation in inputs and the variance in requirement models. These tools can be used to minimize the risk of underfeeding nutrients while minimizing the economic and environmental impacts associated with overfeeding. Future models need to allow economic optimization given a broader set of input and output constraints and costs. Nutritional decisions must be made while considering feed availability and cost, environmental constraints and penalties, management goals and capabilities, facilities, and the genetic potential of the herd.

Key Words: dairy management, nutrition, model

661 A large Markovian linear program model for dairy herd decision-making. V. E. Cabrera*, *University of Wisconsin*, *Madison*.

The purpose of the study was twofold: 1) propose an innovative modeling framework using Markovian linear programming to optimize dairy farm net returns under different decision schemes and 2) illustrate the model with a practical application. A dairy herd population was represented by cow state variables defined by parity (1 to 15), month of lactation (1 to 24), and pregnancy status (0 non-pregnant and 1 to 9 pregnant). A database of 326,000 lactations of Holsteins was used to parameterize reproduction, mortality and involuntary culling. Five diets were studied to assess economic, environmental, and herd structural outcomes. Diets varied in proportions of forage, corn grain, and soybean meal within and between lactations, which determined dry matter intake, milk production, and N excretion. The problem was set up as a Markovian linear program model containing 5580 decision variables and 2792 constraints. The model optimized the net return of the steady state dairy herd population having two options in each state: keeping or replacing an animal. Hence, the model identified the maximum net return that included a cost benefit function of the N excretion associated with the optimal policy. The problem was solved using the Risk Solver Platform with the Standard LP/Quadratic engine. The optimal policy with 2008 milk, feed, and livestock prices called to replace open cows between 11 and 14 months after calving depending on parity and diet, with higher culling rates for lower parities and high corn grain diet. High corn grain diet resulted in $22.8 and $61.8/mo per cow higher net returns compared with intermediate and no-corn grain diets. The model detected an opportunity to substitute corn grain for forage in mid and late lactation to increase net return and decrease N excretion. With lower milk prices and higher feed prices, the model suggested lower replacement rates and increased use of forage to increase net profit, which consequently decreased N excretion.

Key Words: Markov chain, linear programming, dynamic programming

662 Impact of disease on dairy production decisions. D. Galligan*, *University of Pennsylvania*, *Kennett Square*.

Dairy production involves the utilization of resources (animals, land, labour, capital etc.) in the production of products valued by society. Production efficiency of the process is based on the dilution of animal maintenance, replacement cost as well as dairy overhead cost. Yield per cow (milk lbs/cow/year) increased at 1.68% per year while herd consolidation (average number of cows/herd) increased at 4.96% per year from 1996 to 2006. Disease influences the production process in a variety of ways and thus can adversely affect the overall efficiency of resource conversion into useful products. In the US, catastrophic diseases have largely been controlled and now most production limiting diseases involve a complex dysfunction encompassing biology and management. At the herd level, the definition of health has been broadened to not only include attainment of normal physiological values, but also the attainment of specific production targets in an economic context. Diseases differ to the degree that management can mitigate production losses by timely treatments and or optimized culling of the diseased animals. At the public level, sensitivities regarding animal health and environmental impacts are largely based on perceptions regarding production and management practices. These sensitivities can affect product prices or indirectly increase production cost by restrictive legislative actions. Dairy management must understand the broad dimensions in which animal diseases can affect their operations and what tools are available to control their losses.

Key Words: health/disease, economic, management