to identify these genes in leukocytes. Using these techniques we have simultaneously monitored from a few to hundreds of expressed leukocyte genes for differential expression patterns during mid-lactation and periparturition. In this way, we have allowed the leukocytes to tell us their own story about disease susceptibility during periparturition by displaying and quantifying changes in global gene expression patterns. Further physiological studies of interesting differentially expressed genes will help us gain new knowledge about the behavior of gene expression during interesting scenarios such as parturition, intramammary infection, vaccination, and genetic selection. Results of these studies to date will be presented. It is hoped that the new knowledge generated from our work will enable targeted nutritional and drug studies focused on development of novel immunomodulators and mastitis preventatives and therapeutics for periparturient dairy cows. Identified genes will also be studied in our laboratory for the presence of harmful and beneficial mutations that could be taken advantage of using traditional genetic selection to improve mastitis resistance. If highly beneficial genes and alleles are identified, these could be used in the future to develop lines of transgenic cows whose mammary glands have been programmed to specifically target and eliminate intramammary infections. These genetic approaches to bolster immunocompetence should help us counteract any negative effects of selection for high milk yield on mammary immunity

Key Words: Functional Genomics, Periparturition, Mastitis

237 Genetics and Genomics of Susceptibility to Mycobacterial Infection in Cattle. P.M. Coussens*[1], B. Tooker[1], W. Nobis[1], and M.J. Coussens[1], *Michigan State University, East Lansing, MI 48824.*

The Mycobacteria are responsible for significant diseases in man and most animals. In cattle, Mycobacteria are responsible for Johne's disease (M. paratuberculosis) and bovine tuberculosis (M. bovis). As obligate intracellular bacteria, the Mycobacteria have devised ways of surviving in macrophages, one of the animals first lines of defense against such infections. The ability to survive in this hostile environment is a key step in the pathogenesis of Mycobacterial diseases. We have begun studies aimed at understanding interactions of Mycobacteria with the bovine macrophage, using both genetic and genomic tools. Clues from studies in mice and humans have been used to highlight possible genetic elements controlling susceptibility to Mycobacterial infection and to examine various bovine populations for genetic differences in these elements. One such element is the NRAMP 1 gene. In mice the NRAMP 1 gene is directly linked to susceptibility to infection by intracellular Mycobacteria. To evaluate potential roles of NRAMP 1 mutations in the outcome of mycobacterial infections in cattle, we have searched for polymorphisms within the bovine NRAMP 1 coding sequence and analyzed the bovine NRAMP 1 gene structure. These studies suggest that the NRAMP 1 gene is polymorphic in cattle and open the way for analysis of linkage to susceptibility to Mycobacterial infection. To better understand Mycobacterial survival in bovine macrophages, we have applied the tools of functional genomics, using a combination of DD RT-PCR and cDNA microarrays to identify key genes whose expression is altered upon macrophage uptake of Mycobacteria. Gene expression patterns have been cataloged into those genes whose expression is affected by the general process of phagocytosis and those genes whose expression appears to be specifically altered by uptake of Mycobacteria. Differentially expressed genes are then classified according the deduced function or pathway to which their protein products belong. By this process, we hope to elucidate particular pathways within the normal course of macrophage activation that are adversely affected by Mycobacteria. Results of these studies to date will be presented and discussed.

Key Words: Functional Genomics, Mycobacteria, Johne's disease

Latest Development in On-Farm Ultrafiltration

238 Latest Development in On-Farm Ultrafiltration 1. History of On-Farm Ultrafiltration of Milk. John Bruhn*[1], [1] *University of California, Davis.*

Research in the use of membrane processing of milk started in the early 1970's when dairy researchers saw a potential for this technology that was being used to make potable water from saltwater. At that time, the concentration of milk was possible, but problems with fouling, flux rates and difficulties with cleaning and sanitizing of the membrane kept it from being used in the dairy industry. In the early 1980's, the on farm use of reverse osmosis was explored. The farm milk was pasteurized before concentrating in a single pass unit. When the cheese plant received this concentrated milk, it was again pasteurized. The double pasteurization decreased cheese yields, but the on farm process was shown to work. In the 1990's, the on farm membrane processing was installed with a dairy producer cooperative in New Mexico. The concentrating process was evaluated extensively before the regulatory agencies would approve the use in grade A dairy foods. Research established that the concentrating process did not convey any special resistance to the pathogens in the raw milk to standard pasteurization. Nor did pathogens grow faster in the raw milk concentrate. No special resistances or growth advantages were noted. The operating parameters were also defined by the regulatory agencies. With the approval of the regulatory agencies, the membrane concentrated, raw milk became a marketplace reality. The raw milk concentrate is used to fortify solids in milk for cheese making. It also has application in the manufacture of frozen dairy desserts. It has potential for use in any dairy foods where a high quality, milk solid concentarte is needed. Potentially, it also could be used to make a grade A fluid milk product with the addition of water. The advantages of the raw milk concentrate to the dairy and food processor are just being realized.

Key Words: UF, RO

239 Regulatory Issues: Processing and Quality. Alfred Reeb, *New Mexico Department of Agriculture.*

Approximately 20 years ago, the dairy industry first proposed the on-farm ultrafiltration of milk. Initially, the regulatory concerns about the quality of raw milk, temperature of processing, and other processing conditions limited ultrafiltration of milk products to in-plant usage. When on-farm ultrafiltration of unpasteurized milk was proposed in 1994, regulatory concerns about processing conditions and product quality were again expressed. The dairies, the membrane equipment supplier, and regulatory agencies worked together to arrive at an answer for the concerns on the processing conditions of the on-farm ultrafiltration and product quality of the retentate. These regulatory issues concerning the On-Farm Ultrafiltration of Unpasteurized Milk will be addressed in this presentation. Proper design of the Grade A Dairy Plant for Ultrafiltration of the milk was required. The review of the equipment included the monitoring and recording of the temperature of ultrafiltration processing. If the temperature during the ultrafilitration process was greater than 8 °C (45 °F), product was diverted through a flow diversion valve. Testing of equipment and the placement of regulatory seals will be discussed. Bacteriological quality of unpastuerized milk for concentration and unfiltered milk is in compliance with the Grade A Standard. Conformance of this concentrated product to Grade A Standards will be also discussed.

Key Words: Regulatory Issues, Quality of Unpasteurized UF Milk, Processing

240 Applications of membrane filtered cold milk as an ingredient. P. Tong*[1] and H. Vyas[1], [1] *Dairy Products Technology Center, California Polytechnic State University, San Luis Obispo.*

Membrane processing of milk at low temperatures results in a concentrated and/or fractionated milk stream which has been obtained with little to no heating. Such concentrates can then be delivered to an ingredient user and only heat processed once to obtain the final pasteurized product. As a result, any undesirable changes associated with heat processing (e.g., protein denaturation, cooked flavors, etc.) can be minimized. When ultrafiltration membranes are used, modification in protein to lactose ratios, and mineral composition of the concentrate are possible. Therefore, such membrane processed milk concentrates will be desirable as ingredients for cheese manufacture, ice cream manufacture and specialized dairy based beverages and other foods. Use of these ingredients may improve finished product composition control (standardization to more optimum protein to fat or protein to lactose ratios), plant throughput/efficiency, and product overall quality (flavor, texture, etc.).

Key Words: ultrafiltration, membrane, milk