

490 Consumer attitudes toward dairy foods. C. M. Bruhn, *University of California, Davis.*

Taste is the number one reason for selecting food, but interest in nutritional content and special health benefits is also important. Consumers respond positively to the taste of many dairy products, but perceptions of health benefits are not as positive as they could be, perhaps because of the strong association of dairy with high fat. An increasing number of consumers are aware that food can provide special health promoting nutrients. Both traditional nutrients, like calcium, and nutrient components of emerging importance, like probiotics, can increase the appeal of dairy foods. Consumers are aware that dairy products help protect against osteoporosis, and many recognize that they do not get enough calcium, however young and middle aged people incorrectly believed they do not have to guard against this disease until they were older. People are not aware of other benefits of dairy products, such as the potential protection provided by calcium against certain cancers and lowering of blood pressure. Furthermore, people have not heard that diets that include dairy result in faster weight loss. While yogurt is generally perceived as a healthy product, consumers are not aware of the numerous potential benefits that probiotic cultures may provide. Although parents expect children to consume dairy product, modeling this behavior by parents is lacking in many home. Label statements may help alert consumers to a fuller range of dairy advantages. Promotion programs that emphasize the number of servings needed at each stage in the life cycle would provide information not generally known by the public today.

Key Words: Consumer, Calcium, Probiotic

491 Probiotics in health: Their immunomodulatory potential against allergic disorders. Z. Ustunol* and J. J. Pestka, *Michigan State University, East Lansing.*

Prevalence of allergic disease such as asthma, food allergies hay fever and eczema is rising with most rapid increases are observed in developed countries. In the U.S., today, one in every four children and one third of the adult population are reported to have allergies. Although the reason for this increase are not completely known, over the past 20 - 30 years changes in food processing, sanitation, disease eradication and extensive use of antibiotics have been suggest to have altered postnatal immune function and development favoring allergic immune profiles. While the primary reason for atopic diseases may be genetic susceptibility, gastrointestinal microflora is recognized to modulate the local immunological environment and influence systemic immunological events, thus, response to allergens. Probiotic ingestion may alter the gastrointestinal microflora by providing bacterial cells to this ecosystem and have been suggested as potential candidates for immunomodulation and for ameliorating allergic diseases. The major mechanism by which probiotics influence the immune system may relate to their ability to differentially modulate expression of cytokines and co-stimulatory molecules. Probiotic administration can also enhance IgA production, which is thought to be important in clearing of allergens. Although,

the etiology of allergies is complex and the exact mechanisms by which probiotics may affect these diseases are still speculative and mechanistic details are yet to be elucidated, probiotics are already being explored with increasing interest for their therapeutic potential in the management and even primary prevention of allergic disorders. Clinical and epidemiological studies indicate that probiotics potentially may be a viable option for management and prevention of allergies.

Key Words: Probiotics, Immune Modulation, Allergies

492 Nutritional properties of whey proteins. K. J. Burrington*, *Wisconsin Center for Dairy Research, Madison.*

Whey proteins have long been recognized for their functional properties and broad application in foods. Only recently, has interest developed in the nutritional properties of whey-derived food ingredients. Body builders were some of the first consumers to recognize the nutritional value of whey proteins as dietary supplements. Though the body builders' main interest is the muscle repair and building ability of the branched chain amino acids found in whey products, there are many other nutritional benefits associated with selected whey proteins. For example, alpha-lactalbumin, lactoferrin, glycomacropeptide and other whey peptides have been shown to manifest unique nutritional bioactivities. This presentation will review the current knowledge detailing the nutritional properties of whey proteins.

Key Words: Whey Proteins, Nutrition, Bioactivity, Peptides

493 The beneficial role of dairy foods on weight and body fat loss: Where we are and where we are going. D. B. DiRienzo*, *National Dairy Council, Rosemont, IL.*

Obesity has been classified as an epidemic in the U.S. A growing body of evidence indicates that dairy products may be part of the solution, not part of the problem for weight and body fat management. Several studies have indicated an inverse relationship between calcium/dairy product intake and weight/body fat in men, women and children. Animal and in-vitro studies have provided a plausible mechanism on how dairy foods may exert a beneficial effect. Clinical studies have demonstrated that the inclusion of at least three servings of milk, yogurt, or cheese per day can augment weight and body fat loss which occurs from reduced energy intake. Moreover, the impact of dairy foods is greater than calcium supplements or low calcium diets suggesting dairy foods contain additional components, beyond calcium, which impact weight. Additional research is underway or planned to further expand the beneficial impact of dairy foods on weight management. Industry and consumer communication efforts on this relationship have been initiated and expand in 2004 and 2005. This presentation will review the science and communication activities associated this newest benefit of consuming 3+ servings of milk, yogurt or cheese products per day.

Key Words: Dairy Products, Weight Management

Growth and Development: ADSA - Mammary Development - The Role of Progenitor Cells and Nutritional Modulation on Lactation

494 Bovine mammary progenitor cells. S. Ellis*, *Clemson University, Clemson, SC.*

Dairy profitability is dependent on the cyclic development and differentiation of the mammary gland. As in other somatic tissues, a resident population of mammary stem cells is thought to be responsible for supporting the development of the mammary parenchyma. While there is general agreement regarding the existence of mammary stem cells, little else about this important cell population is known. There is a particular lack of information about stem cells in the bovine mammary gland. Data from a number of experimental models suggest that mammary stem cells are scattered throughout the mammary parenchyma and are resistant to stimuli that would promote differentiation. Investigations of prepubertal mammatogenesis in heifers indicate that a histologically distinct population of lightly staining epithelial cells are the primary proliferative cell population in mammary parenchyma. The so-called

light cells have been described in mammary parenchyma of all species examined to date. Unfortunately, the nomenclature relating to these putative mammary stem cells is inconsistent and classification of the cell staining is very subjective. Much of the confusion around mammary stem cells relates to epithelial cells being mistaken for wandering lymphocytes and to the differences between progenitor cells and true stem cells. However, recent ultrastructural studies have clearly shown that light cells do indeed possess epithelial characteristics, and molecular analyses are beginning to identify potential markers that will help identify stem cells in situ. The application of refined embedding, microtomy, and staining techniques for histologic examination with the light microscope has helped to facilitate investigations of putative mammary stem cells, but the experiments are still time-consuming, relatively subjective, and difficult to perform on a large number of tissue samples. Critical needs for future studies of bovine mammary stem cell physiology include: the development of genomic and proteomic information for

bovine model systems; investigations of the ontogeny of mammary stem cell formation, activity, and senescence; and integration of in vitro, genomic, and proteomic information into histologic analyses of mammary development and function.

Key Words: Mammary Stem Cells, Mammogenesis

495 Characterization of gene expression patterns in bovine mammary epithelial cells isolated using laser capture microdissection. B.E. Etchebarne*, M. Kiupel, and M.J. VanDeHaar, *Michigan State University, East Lansing.*

Molecular examination of specific cell populations in primary tissues is necessary to elucidate the mechanisms underlying cellular responses to cytokine and hormonal signals. The inherent heterogeneity of tissues with varying mixtures of reactive cell populations can decrease the sensitivity and accuracy of molecular studies of gene expression. Technological advances in microdissection have allowed for the isolation of homogeneous, morphologically identified cell populations from prepared tissues. When used in conjunction with sensitive analytical techniques, such as quantitative reverse transcriptase polymerase chain reaction (qRT-PCR), microdissection allows precise in vivo examination of gene regulation within the cell population of interest. Using procedures developed in human breast cancer studies, we employed laser capture microdissection (LCM) to study the gene expression profile of epithelial cells in bovine mammary tissues treated with IGF-I and leptin. Our study was performed using frozen samples of bovine mammary parenchyma embedded in OCT compound and sectioned at 8 μ m. Following a brief hematoxylin staining and sequential dehydration, cell sections were air-dried and immediately isolated using the Arcturus Pix-Cell laser capture microscope. Using the SYBR Green-based detection method of qRT-PCR, transcripts for leptin receptor, beta-actin, and forkhead transcription factor FOXO3A were detected in as little as a 1:100 dilution of RNA (equivalent to 10 cells) isolated from a single LCM cap and subsequent cDNA synthesis. Ongoing studies are focusing on characterizing and quantifying relative gene expression between LCM versus whole tissue preparations of specific genes of interest for both epithelial and stromal bovine mammary cell populations.

Key Words: Laser Capture Microdissection, Gene Expression, Mammary

496 Phenotypic and ultrastructural characterization of the developmental pathway of bovine mammary gland progenitor cells. M. S. Holland*¹, L. D. Griffin¹, J. A. Stasko², and R. E. Holland*³, ¹*Veterinary Microbiology and Preventive Medicine, Iowa State University, Ames*, ²*National Animal Disease Center, USDA-ARS*, ³*Veterinary Diagnostic and Production Animal Medicine, Iowa State University.*

A model system that scaled down the mammary gland to its most essential components was developed. Bovine mammary gland progenitor cells (BMGPC) were isolated from the mammary parenchyma by biopsy and collagenase digestion. The isolation process confirmed the parenchyma as one site within the mammary gland that contained mammary stem/progenitor cells. Cell culture techniques were used to purify the BMGPC from other cell types in the mammary gland. Based on ultrastructural analysis, BMGPC were divided into two populations. An undifferentiated population exhibited minimal absorption of osmium tetroxide while the differentiated population exhibited efficient absorption of osmium tetroxide. The two populations also differed in the number and type of cellular organelles. Undifferentiated BMGPC had mitochondria and tonofilaments. Depending on the stage of differentiation, differentiated BMGPC contained mitochondria, tonofilaments, rough endoplasmic reticulum, free ribosomes, golgi apparatus, protein-filled vesicles, etc. The differentiation process in BMGPC appeared to be controlled by the complex cellular microenvironment as indicated by the response of BMGPC to signals from hormones and the extracellular matrix. Our results indicated that components in extracellular matrix elicited a range of responses. While matrigel induced undifferentiated BMGPC to differentiate, laminin, collagen I and IV induced minimal differentiation. Signals from hormones and growth factors were also key in inducing differentiation. In conclusion, we produced a cell line for functional studies of the mammary gland.

Key Words: Progenitor Cells, Differentiation, Ultrastructure

497 Effects of energy intake and time to puberty on mammary growth of prepubertal Holstein heifers. M. J. Meyer*¹, A. V. Capuco², and M. E. Van Amburgh¹, ¹*Cornell University, Ithaca, NY*, ²*USDA-ARS, Beltsville, MD.*

In the bovine, early postnatal mammary growth is thought to occur at an allometric rate and return to an isometric rate after puberty. Elevated energy intake prior to puberty has been shown to retard mammary parenchymal (PAR) DNA content at puberty, however, a causative relationship between PAR DNA at puberty and future milk yield has yet to be substantiated. Our objectives were to describe effects of increased energy intake from shortly after birth on 1) total PAR and fat pad (FP) DNA, 2) PAR DNA accretion rates, and 3) timing of the prepubertal allometric growth phase. Holstein heifers (n = 78) were fed from 45kg either elevated (E) or restricted (R) levels of energy to achieve divergent rates of gain (E 950 g/d; R 650 g/d). Six heifers per treatment (TRT) were slaughtered at 50kg increments from 100 to 350kg. Six were slaughtered at 46kg, at which time PAR was difficult to discern and present as a small cord of tissue. FP weights were similar between TRT up to 200kg but were heavier from 250 through 350kg in E-heifers (P < 0.05). However, FP DNA content was similar between TRT until 350kg, at which point FP DNA was greater in E- than R-heifers (P < 0.05). PAR DNA was similar between TRT up to 200kg. From 250 through 350kg, R- had more PAR DNA than E-heifers (P < 0.05). Interestingly, daily PAR DNA accretion rates, calculated between consecutive slaughter points, were not influenced by energy intake (P = 0.98). This rate reached a peak of 5.4 mg PAR DNA per day between 200 and 250kg and declined precipitously during the peripubescent period. A plot of the log BW vs. log PAR DNA indicates that mammary growth rate, independent of TRT, was allometric by 100kg BW and became isometric shortly before puberty (puberty occurred at 280kg independent of TRT). These data demonstrate that reductions in mammary PAR DNA associated with elevated rates of gain result from a reduction in time to puberty rather than impairment of epithelial cell proliferation and PAR DNA accretion.

Key Words: Heifer, Mammary Development, Puberty

498 Nutritionally directed compensatory growth affects mammary cell proliferation and apoptosis. C. S. Park*, *North Dakota State University, Fargo.*

The proper application of a time-dependent and closely controlled nutrition regimen during different growth stages prior to first parturition can affect mammary development and subsequent lactation potential. We have developed a compensatory growth nutrition regimen which is a combination of dietary energy restriction and realimentation phases designed to regulate mammary development. The basic concept of this nutrition regimen is to exploit the biological nature of the energy restriction and compensatory growth phenomenon in concert with one or more hormone-sensitive allometric phases of mammary development (i.e., peripuberty through gestation). We have examined various models for developing dairy and beef heifers, gilts, and rats. General observations are that compensatory growth regimens have positive effects on mammogenesis and lifetime lactation performance. The synergistic interaction of nutritionally induced compensatory mammary growth with developmentally related allometric growth causes a cascade of up-regulation of various genes which affect cellular activity and regulate the cell cycle. Compensatory growth causes permanent hyperplasia and hypertrophy of mammary alveolar epithelial cells, thereby stimulating mammary development and differentiation as evidenced by increased expression of ornithine decarboxylase and β -casein. The decrease in epithelial cell death in compensatory mammary tissue may be closely related to an increase in the expression of insulin-like growth factor-I which affects both cell cycle progression and apoptosis. Our recent studies with expression profiling by gene array analysis reveal that compensatory mammary growth modulates genes associated with a broad range of metabolic pathways or physiological functions (i.e., proliferation, differentiation, secretion, cellular communication, apoptosis, lipogenic and myogenic pathways, and tissue remodeling). By altering the expression of cell cycle genes, compensatory mammary growth provides a potential means to manipulate mammary function and lactation.

Key Words: Compensatory Growth, Mammary Cell Proliferation, Apoptosis

499 Effects of a high rate of gain for increasing lengths of time on body and mammary growth in prepubertal dairy heifers. L. E. Davis*, M. S. Weber Nielsen, L. T. Chapin, J. S. Liesman, and M. J. VandeHaar, *Michigan State University, East Lansing.*

A high rate of gain in dairy heifers for #8805 3 mo is detrimental to prepubertal mammary growth and subsequent milk yield. However, the effects of a high rate of gain for shorter periods have not been reported. Our objective was to compare effects of high (1200 g/d) and low (600 g/d) rates of gain over different lengths of time (0, 3, 6, 12 wk) on body and mammary growth. Heifers (age = 11 wk, n = 64, BW = 107 kg, SE = 1.0) were randomly assigned to 1 of 4 treatments: H0 (low diet fed for 12 wk); H3 (low diet fed for 9 wk followed by high diet for 3 wk); H6 (low diet fed for 6 wk followed by high diet for 6 wk); and H12 (high diet fed for 12 wk). Animals were slaughtered at 23 wk of age. Statistical analysis used the GLM procedure of SAS and tested multiple comparisons using the Bonferroni test. Statistical significance was declared at $P < 0.05$. Average daily gain and final live weights were different for all comparisons except H0 versus H3 (H0 = 662, H3 = 660, H6 = 848, H12 = 1124 g/d, SE = 12; H0 = 165, H3 = 166, H6 = 181, H12 = 203 kg, SE = 1). Final withers height was greater for H6 and H12 (H0 = 100, H3 = 100, H6 = 102, H12 = 104 cm; SE = 0.3). Carcass wt were different for all comparisons (H0 = 77, H3 = 82, H6 = 92, H12 = 107 kg; SE = 1). Mammary hemigland mass increased with time on high diet (H0 = 529, H3 = 591, H6 = 768, H12 = 864 g/100 kg carcass wt; SE = 43). Mass of perirenal fat also increased with time on the high diet (H0 = 900, H3 = 1181, H6 = 1608, H12 = 1794 g/100 kg carcass wt; SE = 105). Short-term changes in diet altered growth of body and mammary tissues. Composition analysis of carcass and mammary tissues are ongoing.

Key Words: Growth, Heifer, Mammary

500 Long days that hasten puberty do not reduce lean body growth in heifers. A. G. Rius*¹, P. E. Kendall¹, T. L. Auchtung¹, A. V. Capuco², E. E. Connor², and G. E. Dahl¹, ¹*University of Illinois, Urbana,* ²*USDA-ARS, BGFL, Beltsville, MD.*

Photoperiod affects growth and development in many species with long day photoperiod (LDPP; 16L:8D) hastening the onset of puberty and enhancing lean growth in cattle. Appropriate body scale is crucial in heifers at first parturition. However, accelerating prepubertal growth may diminish mammary parenchymal growth. Nutritional factors including metabolizable protein also affect the onset of puberty, body and mammary growth in heifers. Our objective was to determine if LDPP hastens the onset of puberty without limiting skeletal growth, (i.e. height). We also sought to determine if the response to LDPP is limited by protein availability. Holstein heifers (n = 32) were assigned to 1 of 4 treatments in a randomized complete block design and a 2x2 factorial arrangement to assess effects of photoperiod and dietary bypass protein on the onset of puberty and body growth. Treatments were LDPP, short day photoperiod (SDPP; 8L:16D), high or low dietary bypass protein. Blood samples were analyzed for PRL concentration to confirm a photoperiodic response and for progesterone to determine puberty. Body weight (BW), withers height (WH), hip height (HH), and heart girth (HG) were measured every two weeks. After puberty, heifers were housed under natural photoperiod and body measurements were continued to evaluate body growth postpubertally. Heifers exposed to LDPP reached ($P < 0.02$) puberty 20 d earlier than animals on SDPP. Increasing dietary bypass protein did not affect growth of heifers (BW, WH, HH or HG) on either photoperiod treatment. However, heifers previously exposed to SDPP gained 22 kg more ($P < 0.05$) of BW after puberty than did heifers previously exposed to LDPP. These data support the use of photoperiod as a non-invasive technique to hasten skeletal without limiting lean growth and development in heifers.

Key Words: Photoperiod, Growth, Heifer

PSA World Poultry Science Lecture

501 Reducing the carriage of foodborne pathogens by livestock and poultry. M. P. Doyle*, *Center for Food Safety, University of Georgia, Athens.*

Livestock and poultry are frequently asymptomatic carriers of human enteric pathogens. Salmonella, Campylobacter and Escherichia coli O157:H7 can reside in the animal's gastrointestinal tract and be shed in feces that subsequently contaminates food and water. Practical, effective on-farm interventions are needed to provide greater protection of the environment and the food supply. Progress is being made on several

fronts in developing useful strategies for pathogen control in animals. Examples include competitive exclusion microorganisms, vaccines, bacteriophages, water/feed treatments, and husbandry practices. Reducing pathogen carriage by animals on the farm can have a major impact on reducing contamination of the environment, water and food, thereby providing greater public health protection.

Key Words: Foodborne Pathogens, Competitive Exclusion, Preharvest Interventions

Animal Behavior & Well Being II

502 Correlating spatial learning, social recognition and aggression in young pigs. J. M. Siegford*, A. S. Souza, J. Jansen, and A. J. Zanella, *Department of Animal Science, Michigan State University, East Lansing.*

We examined cognitive abilities and agonistic behavior in young female pigs to determine whether spatial learning (SL) was correlated with social recognition (SR) and post-mixing aggression. SL and SR require activation of the hippocampus, thus they may be correlated. Therefore, pigs performing well in SL should remember other pigs more easily in SR and might use information of previous social encounters to avoid fights when mixed. SL of pigs was tested twice (d13 and d14) using a modified water maze (WM) in which pigs in a pool of opaque water locate a submerged platform (5 exposures per pig separated by 10min). Good (GP; n=23) and poor performers (PP; n=24) were selected based on latencies from previous WM results for pigs of this age. Using average latencies from exposures 2-5 on both days, criterion for GP was < 55 s and criterion for PP was > 70 s. Animals were familiarized at d20 and d21 in arenas divided by flexible netting. SR testing was subsequently carried out at d21 and d22. At d23, all pigs were weaned. On d24, piglets were retested in the WM. Latency continued to decrease, suggesting weaning did not disrupt memory of the WM task, but no difference in latency was seen between GP and PP ($F_{1,47}=0.04$; $p=0.84$). At d25, pigs were mixed in groups of 6 GPs (n=4) or PPs (n=4) and duration and number of fights were monitored for 1 day. Pre-mixing familiarization led to a decrease

in post-mixing fights ($F_{1,43}=4.75$; $p=0.03$; 7.26 ± 1.49 vs. 4.46 ± 0.69). In the first 3 hours post-mixing, unfamiliar PPs fought more than other groups ($F_{1,43}=14.33$; $p < 0.001$; 13.67 ± 2.32 vs. 5.22 ± 2.22), suggesting a correlation between SL and post-mixing aggression. Duration of fights was affected by interaction of day with familiarity ($F_{1,43}=4.61$; $p=0.04$) and time of day with WM performance ($F_{1,43}=4.41$; $p=0.04$). Additional animals are being tested to strengthen findings, which suggest familiar pigs and possibly GP fight less. Protocols could be developed to familiarize litters to reduce post-mixing aggression in production.

Key Words: Behavior, Welfare, Learning

503 Acute stress impairs spatial learning and social recognition in early-weaned pigs. A. S. Souza*, K. Laughlin, J. M. Siegford, and A. J. Zanella, *Department of Animal Science, Michigan State University, East Lansing.*

We investigated whether weaning age and social isolation disrupt spatial learning (SL) and/or social recognition (SR) in newly-weaned pigs. Female pigs were early-weaned at d11-12 (EW; n=48) or conventional-weaned at d23 (CW; n=48) and social isolation (SI) for 15 minutes occurred immediately before testing each pig once in either SL or SR. We assessed SL using a modified water maze, in which pigs in a pool of opaque water and must locate a submerged platform. The latency to reach the platform from a pre-determined release point was recorded