growth of bacteria, and may reduces contamination of bacteria in broiler chickens.

Key Words: AMMFOR-pH, Broiler, Drinking Water

PSA-Extension/Instruction

M304 Development of a quality control laboratory design project for poultry science undergraduate students enrolled in an advanced food microbiology course. R. S Hardin*, M. M. Kundinger, C. L Woodward, L. M Donalson, J. L Golbach, and S. C Ricke, *Department of Poultry Science, Texas A&M University, College Station*.

With the ever-increasing demand for problem solving skills in todays poultry workforce, more emphasis is needed on integrated training at the undergraduate level. An exercise for designing a quality control laboratory was developed as a laboratory group project in a senior level undergraduate advanced food microbiology course taught in the poultry science department at Texas A&M University. The assignment was based on the students designing their own laboratory and implementing testing methods for different types of bacteria known to cause foodborne illness. They were responsible for determining what equipment was needed for their specific pathogen as well as general supplies and materials required for setting up a fully equipped laboratory. Individual research papers were required of each student midway through the semester to gain a sufficient background on the pathogen; including discussion of the importance, detection methods, and the prevention and control of the pathogen assigned to their group. In each of the laboratory sections students were separated into groups of four students who were then responsible for a group project report. At the end of the semester the group report was required to include a lab diagram indicating where equipment would be placed as well as a comprehensive budget including a list of prices needed to set up the laboratory designed by the group. The group project report was also required to contain justification for specific equipment and materials requested, based on the pathogen and scenario given to the groups discussed where samples would be taken from, how often samples would be taken, as well as what isolation methods would be used. Students were also required to develop waste management procedures to handle all possible biohazard materials. Successful completion of the project provided students with problem solving skills essential for the poultry industry.

Key Words: Food Microbiology, Review Paper, Quality Control Laboratory Design

M305 Student understanding of molecular genetics concepts. B. S. Walters* and T. J. Buttles, *University of Wisconsin, River Falls*.

The purpose of this study was to increase student understanding of molecular genetics concepts. Current students in colleges of agriculture will be entering a world shaped by biotechnology. Applications of biotechnology such as genetically modified crops have been adopted at a rate greater than any other technology in the history of agriculture. Animal applications of biotechnology are also on the rise and raise additional ethical questions. DNA transcription, RNA translation, and protein structure development all play a key role in modern applications of biotechnology. An understanding of these processes lays the foundation for understanding the bigger picture of biotechnology applications in agriculture. The goals of this Scholarship of Teaching and Learning project were to first identify students' background knowledge and then to evaluate the effectiveness of different instructional approaches in increasing student understanding. The starting point for the project was to determine the level of understanding students brought to the course. Students were given the opportunity to complete a short questionnaire asking for related course information (completed or in-progress: Introductory Biology, Animal/Plant Genetics, Animal/Plant Breeding, Introduction to Biotechnology) and definitions of 5 terms (messenger RNA, transfer RNA, ribosomal RNA, transcription, translation). Nearly all students had completed Introductory Biology and at least one additional course that included molecular biology concepts. Despite this background, few students could correctly define all 5 terms. Based on these findings, classroom activities were developed where students examined the core molecular genetics concepts from a variety of perspectives.

Key Words: Undergraduate Education, Teaching, Biotechnology

M306 What does the poultry industry want when recruiting undergraduates? - an ongoing perspective survey to evaluate the importance of certain employable skills to the poultry industry. K. M. Downs*[1], J. E. Mehlhorn[2], J. B. Hess[3], and J. L. Wilson[4], [1]*Middle Tennessee State University, Murfreesboro,* [2]*The University of Tennessee at Martin, Martin,* [3]*Auburn University, Auburn, AL,* [4]*The University of Georgia, Athens*.

A survey instrument was developed to assess personality traits and competency levels important to poultry managers for achieving success in the poultry industry. Twenty questions seek to evaluate the importance of personality characteristics and subject matter competencies sought in new employees. Remaining questions evaluate the importance of seven common industry recruitment efforts. A Likert scale (1=unimportant to 5=critically important) is used to quantify responses, and managers in all phases of broiler and table egg production are targeted. Surveys are mailed with an explicative cover letter, self-addressed stamped envelope, and appreciation gift. At present, personnel in TN, AL, and GA have been targeted; however, to strengthen statistical inferences, administration will continue.

Response rate is currently 52.3%. Most managers completing the survey classified themselves as working in the processing (36%), live production (23%), or HR (19%) sector. To date, respondents (n=23) indicate the five most important characteristics for employment success are integrity (4.87), teamwork (4.83), adaptability (4.39), problem-solving (4.39), and oral communication (4.39). Conversely, the five least important parameters were undergraduate major (2.74); knowledge of foreign language (2.83), basic science (2.83), or computer hardware (2.87); and previous work experience (2.91). Respondents evaluated the most effective recruitment tools to be departmental career fairs (3.64) and informal university contacts (3.64). Trade publications (2.48) and on-line job sites (2.40) were considered the least beneficial for recruitment.

Developing aptitude in team building, problem-solving, and oral communication should be priorities in undergraduate education. Furthermore, fostering strong industry ties should be a significant objective of those in academia to more effectively place students in the poultry industry. This collaborative work is ongoing.

Key Words: Undergraduate Education, Recruitment, Poultry Industry

Milk Protein and Enzymes: Dairy Foods

M307 Exploring the structure and dynamics of labeled β-lactoglobulin using high field NMR spectroscopy. P. J. B. Edwards[1], G. B. Jameson[1], G. E. Norris[2], T. S. Loo[2], K. A. N. S. Ariyaratne[1], D. Uhrín[3], P. N. Barlow[3], and L. K. Creamer*[4], [1]*Institute of Fundamental Sciences,* [2]*Institute of Molecular Biosciences,* [3]*Edinburgh Protein Interaction Centre,* [4]*Fonterra Research Centre*.

Bovine β-lactoglobulin (BLG) is the major whey protein and dominates the effects of heat and pressure on the structure and disulfide bonding of this protein. The two common genetic variants, BLG A and BLG B, behave quite differently in their reactions. For example, BLG A is more readily hydrolyzed and easier to heat denature than BLG B. The X-ray crystal structures do not show any features that could explain this behavior and consequently an extensive project was initiated to resolve this question. A polynucleotide was synthesized and expressed to give fusion proteins, corresponding to both the A and B variants. These were subsequently cleaved to obtain synthetic BLG A and BLG B. Addition of 15N and/or 13C nutrients to the growth media allowed labelled proteins to be made and these have been used to confirm the previously

published assignments for the A variant and to assign residues close to the substitution sites in the B variant. Using this base information the accessibility of each of the amide N atoms was determined as a function of temperature using H/D exchange. Preliminary results of a 15N NMR relaxation study indicate some small differences in the backbone dynamics of BLG A and BLG B. The significance of these results will be discussed in terms of the different stabilities of BLG A and BLG B.

Key Words: Molecular Dynamics, Labeled Lactoglobulin, Temperature Effects

M308 Water distribution in cheese and cheese models: Application of NMR techniques, including the inverse 2D-LaPlace transform. A. Gottwald[1], P. L. Hubbard[1], P. T. Callaghan[1], P. J. Watkinson[2], and L. K. Creamer*[2], [1]*School of Chemical and Physical Sciences, Victoria University of Wellington, New Zealand,* [2]*Fonterra Research Centre, Palmerston North, New Zealand.*

Most cheese is a complex dispersion of protein (casein), butterfat, and their degradation products, in water containing some mineral material. Using a 7 T NMR spectrometer (300MHz for 1H) 1H signals of water and oil can be resolved by chemical shift differences. The protein signals are usually overwhelmed by these two major signals because of the differences in relaxation time. NMR-relaxation (T_2) and NMR-diffusion (D) were determined for the water and were then transformed to give two-dimensional (2D) plots of D vs T_2. There were a number of spots on the 2D plot and this indicated that there were several water environments. A similar plot was obtained from the butterfat signal. For a better understanding of the origin of different relaxation rates and/or diffusion coefficients, cheese models with a simpler composition were prepared and studied under similar conditions as the cheese. The simplest model was sodium caseinate dissolved in water at neutral pH. The simplest butterfat model was liquid paraffin oil, in which all protons are bonded to carbon, which was emulsified into the caseinate solution. Further complexity was introduced by replacing some of the sodium ions with calcium. This changed the concentrated caseinate solution with emulsified oil into a semi-solid visco-elastic material. Diffusion coefficient D and relaxation time T_2 of the water protons in the models are similar to the values in real cheese. Both values (D and T_2) decrease if the protein content in the model system is increased. The NMR behavior of the oil, which exists in discrete droplets, is unaffected by protein concentration. On the other hand, there are some significant differences between natural cheese and these model systems which clarifies our understanding of the natural cheese system.

Key Words: Cheese Water Mobility, Caseinate Solution, Model Cheese System

M309 Effects of genetic modification, pressure, and heat on the binding of various probes to β-lactoglobulin. H. A. Patel[1,2], T. Considine[1,3], S. G. Anema[3,2], H. Singh[3], and L. K. Creamer*[1], [1]*Fonterra Research Centre, Palmerson North, New Zealand,* [2]*Institute of Nutrition, Food and Human Health, Massey University, Palmerston North, New Zealand,* [3]*Riddet Centre, Massey University, Palmerston North, New Zealand.*

Native β-lactoglobulin (BLG) has been shown to bind a number of hydrophobic and amphipathic molecules within the central calyx. Examples are: hexane, retinol (vitamin A), cholesterol, 12 bromo-dodecanoic acid, palmitic acid, and cis-parinaric acid (CPA) but not anilinonaphthalene sulfonate (ANS). The binding of retinol and CPA can be followed by induced circular dichoism or increased fluorescence. This has allowed the determination of the displacement of CPA or retinol by dodecyl sulfate (SDS) or palmitate, but not by ANS. Heat treatment denatures the BLG, and the binding of CPA and retinol decreases in proportion with the extent of denaturation while ANS fluorescence increases. Pressure treatment has a similar effect. Addition of these ligands of BLG increases the stability of the protein under increased temperature and pressure. ANS does not have this effect. Polynucleotides were synthesized and expressed to give fusion proteins, corresponding to both the A and B variants of BLG. These were subsequently cleaved to obtain synthetic BLG A and BLG B. Modification of the polynucleotide allowed the preparation of a number of different BLG mutants. Some of these were modifications close to the binding site of retinol and the fatty acids. In particular the change of lysine to glutamic acid at residues 60 and 69 showed dramatic differences in behavior. These two residues are close spatially but the change at residue 60 prevents binding of retinol or CPA while that at residue 69 does not.

Key Words: Whey Protein Concentrate, Heat Treatment, Pressure Treatment