

Developing and Sustaining International Agriculture Experiences in Animal Science Curricula

246 The nuts and bolts of student exchange programs. John C. Forrest*, Terry S. Stewart, Bud G. Harmon, and Michael H. Stitsworth, *Purdue University*.

Exchange programs prepare animal sciences students to participate in the emerging global economy. Purdue's successful international undergraduate exchange developed from a long history of international programs and faculty exchanges. Emphasis on student exchanges during the last decade stems from recognition that economic development of the agricultural sector depends upon a better understanding of the cultures that drive international trade. The first formal undergraduate animal agriculture exchange program developed out of a faculty sabbatical to Australia. Prior to that several animal sciences students participated in general agricultural exchange programs sponsored by International Programs in Agriculture.

Exchange programs that provide the most beneficial experiences for students are well organized by participating institutions. When possible equal numbers of students from each university should be recruited. A great economic deterrent to recruitment was overcome when university administrators allowed students to pay tuition to their home institution while participating in exchanges, and revenue remains constant for both institutions. Mentors with a strong interest in students and knowledge of the programs at the collaborating institution help programs go smoothly at both ends of an exchange. This is especially important in initial exchanges. When exchanges are ongoing, students tend to form networks between universities that are beneficial to new students.

Exchanges take many forms, from formal funded programs that generally include one full semester of courses at a host university, to summer work experiences. In some cases a work experience is either preceded or followed by a semester of resident instruction. Exchanges with developing countries generally require funding to allow students from those countries to participate, host families often help offset housing costs for students coming to the US, and provide cultural understanding beyond the normal university experience. Exchanges with developed countries are fostered by agreements that allow students to pay tuition at their home campus. Scholarships and other financial assistance are often provided to assist students with travel and extra expense of living in a foreign country.

Key Words: Student exchange programs, International exchange programs, International Animal Agriculture

247 The Linkage Project: a partnership in international educational development. M. D. Kenealy*, *Iowa State University, Ames*.

The Linkage Project was developed to create a model for US and international universities to align curricula to improve access to undergraduate and graduate programs for international students. The project proposal was driven by the need for increased globalization of education. If universities throughout the world are to capitalize fully on available knowledge and methodologies, they must prepare students who can move seamlessly through educational systems worldwide. Representatives of seven agriculture or veterinary medicine disciplines from Iowa State University (ISU) and National Agriculture University of Ukraine (NAUU)

partnered for a four-year effort funded by the United States Information Agency. Disciplines represented were: agricultural education, agricultural engineering, agronomy, animal science, economics, forestry, and veterinary medicine. Procedural steps were: 1. year one: one month exchanges of faculty counterpart teams from each discipline to study educational programs at the cooperating institutions and develop aligned bachelor of science (BS) programs; 2. year two: exchanges to finalize curricular proposals at ISU, open forums at NAUU to promote new BS programs to faculty and administration, and curricular implementation; 3. year three: on-site evaluation of the first year of implementation of BS programs and initiation of development of new master of science (MS) programs at NAUU; 4. year four: final adjustments and implementation of MS programs at NAUU. Faculty and students from the two universities involved in the Linkage Project benefited from accomplishment of the primary project objective of aligning curricula to enhance the process of student exchange, transfer, and graduate enrollment. Secondary benefits included internationalization of faculty and students, increased awareness of education on a global scale, and new opportunities for research partnerships. Additionally, the project positioned NAUU as a lead institution and model for preparing agricultural students for the changing economic system of the countries of the former Soviet Union.

Key Words: International, Curriculum

248 Developing/funding of exchanges of faculty and other international symposia related to teaching and research. J. F. Keown*¹, ¹*University of Nebraska, Lincoln, NE*.

The Institute of Agriculture and Natural Resources at the University of Nebraska is a member of the Mid America International Agricultural Consortium. This Consortium consists of the Agricultural Colleges located at the University of Missouri, Iowa State University, Kansas State University and Oklahoma State University. The main focus of this group is to work with Mexican Institutions to further research, teaching and extension with Mexican Universities, Governmental Research Centers, private industry and producer groups. The sole focus of this group is to work in the agricultural sectors of livestock and meats, biotechnology, wheat, maize, natural resources and current women's issues. This group has formed "sister university" relations with several Mexican Universities, held symposia in Mexico in the biotechnology, conservation tillage, exploring women's issues and by-product feeding. This consortium in previous years has spent considerable time and effort working overseas with USAID grants. With the reduction in USAID funding, the consortium took a different mode of action and decided to work mainly with Mexico. The Board of Directors, comprised of the Agricultural Deans at all five universities, changed due to the importance of the agricultural exports that flow to Mexico from this five-state region, as well as the increasing number of Mexican workers currently working in this five-state region in the meat packing, construction and general agricultural areas. The consortium feels that an exchange of scientific knowledge and of students and faculty will enhance economic development of both countries.

Key Words: MIAC, Mexico, Consortium

ADSA Dairy Foods: Dairy Products—Chemistry and Physical Properties

249 Methods to Prepare Glycomacropeptide from Cheese Whey. Takuo Nakano* and Lech Ozimek, *University of Alberta*.

Glycomacropeptide (GMP) found in cheese whey (or sweet whey) is a biologically active compound, and thought to be a potential ingredient for dietetic foods and pharmaceuticals. Thus, much attention has been given to the development of techniques to isolate and purify this glycopeptide. The objective of this study was to develop techniques to prepare GMP from sweet whey under a laboratory scale. We have developed the following techniques: 1) gel chromatography on Sephacryl S-200 in 0.1 M sodium acetate at pHs 7.0 and 3.5; 2) cetylpyridinium chloride treatment, and gel chromatography on Sephacryl S-200 in 0.1 M sodium acetate (associative condition) and on Sephadex G-75 in 6 M guanidinium chloride (dissociative condition); and 3) deproteinization with trichloroacetic acid and gel chromatography. In all the techniques

used, we obtained high purity GMP with amino acid composition having a trace (< 1 residue/ peptide) of phenylalanine (amino acid that does not occur in GMP). These techniques are useful to prepare GMP as a research chemical. The purified GMP may be used as a standard in chromatography and electrophoresis, and may also be used to test various known or unknown biological activities of this glycopeptide.

Key Words: Glycomacropeptide, Cheese whey, Purification

250 Scale up and mass balance of affinity purification of native β -lactoglobulin. Harit K. Vyas*, J. M. Izco, and R. Jimenez-Flores, *Dairy Products Technology Center, Cal Poly*.

The process of affinity purification of β -lactoglobulin in its native form using all-trans-retinal immobilized on Celite R-648TM was scaled up and applied to fractionate industrial sweet whey. Three different ways

of mixing the Celite R-648TM and whey for the interaction between all-trans-retinal and β -lactoglobulin were tried at pilot scale. The three methods used were (1) a continuous operation using a column packed with Celite R-648TM, (2) a batch operation in a stirred tank and (3) a continuous operation using a fluidized Celite R-648TM column. Adsorption and desorption of β -lactoglobulin were carried out at pH 5.1 and 7.0, using 0.01 and 0.1M phosphate buffers, respectively. The phosphate buffer containing desorbed β -lactoglobulin was concentrated 20 times using ultrafiltration and then freeze-dried. The packed column, stirred tank and fluidized column produced β -lactoglobulin with purity of 80, >95 and >95%, and recovery of 0.65, 2.88 and 2.88g per kg of Celite R-648TM, respectively. The comparative poor purity and recovery of β -lactoglobulin in the case of the packed column was attributed to insufficient contact between the passing fluids and the Celite R-648TM during adsorption, desorption and intermittent washing. The fluidized column method being a continuous operation with a gentle mixing action, was considered the best suited for further scale up to the industrial level.

Key Words: Process scale up, affinity purification, β -lactoglobulin

251 Separation of proteins from acid whey using clay minerals. J. Su and D. W. Everett*, *University of Otago, Dunedin, New Zealand.*

The adsorption and desorption behavior of whey proteins on clay minerals was investigated. Bentonite, halloysite, and kaolinite from New Zealand and eckalite from Australia were suspended in 1% (v/v) H₂O₂(aq) and stirred over a period of 6 days to oxidize organic surface impurities. To create a homoionic surface, minerals (except bentonite) were washed 4X in 1M NaCl at pH 2.6-3.0. Bentonite was washed 4X in 1M CaCl₂ at pH 2.6-3.0 to avoid mineral coagulation. All four mineral samples were then washed in deionized water until the conductivity approached that of the water. Acid whey (HCl, pH 4.6) was added to each clay sample in the ratio of 20:1 (v/w) for kaolinite, eckalite, and halloysite, and 10:1 (v/w) for bentonite. The pH was adjusted for each of eight samples of the four mineral-protein complex series in the range pH 3-10. Samples in triplicate were agitated for 60 min, centrifuged at 11,000 X g for 5 min at 4°C, and the supernatant examined for protein composition by SDS-PAGE and densitometry.

Proteins (α -LA, β -LG, and lactoferrin+BSA) were completely adsorbed up to pH 4 onto kaolinite, eckalite, and halloysite and up to pH 7 for bentonite, dropping to 10% adsorption onto kaolinite, 20-40% onto halloysite, 30-70% onto eckalite, and 60-95% onto bentonite at pH 10, the level of adsorption depending upon the protein. Adsorption of β -LG onto eckalite was significantly higher (70%), and significantly lower for α -LA onto bentonite (60%) compared to other proteins. Adsorption of 60kDa IgG was 100% complete over the range pH 3-10 on all four mineral surfaces. The level of desorption of bound proteins was measured by agitating for 60 min and washing the complexes in (1) distilled water, (2) 0.1, 0.2, 0.5, 1 and 2M NaCl, (3) 0.1% β -mercaptoethanol + 2M NaCl, (4) 6M urea, or (5) 6M urea + 2M NaCl. Washing the pH 3 complexes with solutions 1-3 did not result in any measurable protein desorption. Washing the pH 3 complexes with solution 4 resulted in 3-12% desorption of β -LG, and up to 25% desorption of β -LG in solution 5 from all clays. Desorption of other proteins was not detectable. Clay minerals may afford an inexpensive method to isolate β -LG from acid whey.

Key Words: Clay Minerals, Whey Proteins

252 Effect of β -casein addition on MFGM-stabilized soy oil emulsions. K. Hutchby and Everett D. W.*, *University of Otago, Dunedin, New Zealand.*

The binding and aggregating effects of β -CN addition to soy oil emulsions coated with milk fat globule membrane (MFGM) material were examined. Raw cream was phase-inverted and buttermilk collected. Casein micelles were dissociated by citrate addition and the MFGM recovered by centrifugation at 100,000xg for 50 min at 15°C followed by freeze drying. MFGM-stabilized soy oil emulsions (1% MFGM, 10% soy oil, w/w) were prepared using a MicrofluidizerTM (40 passes) at an effective outlet pressure of 75 MPa. Globule diameter was determined by photon correlation spectroscopy at pH 4.8 to 5.8 in 0.2 unit increments in a 20 mM sodium acetate buffer, and at pH 7.0 in a 20 mM Tris-HCl buffer, before and after β -CN addition. Emulsion dilution factor was 1 μ L per 2 mL of filtered buffer. Ten measurements were made every 5 min for duplicate samples.

Hydrodynamic diameter was 600 \pm 50 nm at pH 7 and remained in the range 550-725 nm down to pH 5.4. Below this pH the diameter increased, rising to 1060 \pm 175 nm at pH 4.8. Addition of β -CN reduced the diameter within a 5 min period, the greatest decrease at pH 5.2 from 725 \pm 150 to 150 \pm 30 nm. Decreases in diameter at the pH extremes was of order 100 nm. Trypsin (3 μ L of 0.01 g/mL in 20 mM Tris-HCl at pH 7) was added to the MFGM-stabilized globule and to the emulsion after β -CN addition, both at pH 5.2. There was no effect on diameter when β -CN was not previously added. The diameter increased from 160 to 330 nm over a 15 min period after β -CN addition, followed by a rapid increase to 1100 nm over 5 min after trypsin addition, indicating extensive aggregation after the initial dispersing. Emulsions stabilized with MFGM aggregated over the pH range 4.8 to 7.0, with more loose and extensive aggregates forming at pH 4.8 nearer the pI of MFGM. β -CN may bind to the MFGM surface and disperse the aggregates by a steric stabilization mechanism. Hydrolysis of the hydrophilic flexible "tail" of β -CN by trypsin caused the globules to aggregate again. These results show that it is feasible to disperse a food emulsion coated with MFGM using β -CN. In addition, it is likely that fat globules in cheese interact with the β -CN of the casein matrix, holding the globules into place.

Key Words: Emulsions, Casein, Photon Correlation Spectroscopy

253 Characterization of dephosphorylated β -Casein. F. Haidari*, L.E. Metzger, and D.E. Smith, *University of Minnesota, St. Paul, MN.*

A method for isolation of β -casein, developed at the University of Minnesota, has allowed access to large quantities of purified β -casein. In this research, β -casein was isolated using the aforementioned method and then dephosphorylated utilizing a known method for dephosphorylation of caseins with slight modification. In this procedure, β -casein is enzymatically dephosphorylated with potato acid phosphatase (28 units per 1 g protein) for 72 hours at pH 7 at 4°C. The reaction takes place in a dialysis tube (12400 M.W. cutoff) against water which removes free phosphates that inhibit the enzyme activity. The protein solution is heated to 85°C to inactivate the enzyme and then lyophilized. This experiment was repeated with three separate lots of isolated β -casein. The degree of dephosphorylation was confirmed by ³¹P-NMR spectroscopy, inductively coupled plasma spectroscopy, and fast protein liquid chromatography. The results indicated that the extent of dephosphorylation was more than 90 percent. The dephosphorylated β -casein was further purified with anion exchange chromatography. The secondary structure of the highly purified dephosphorylated β -casein was studied and compared to that of the native β -casein by utilizing FT-IR spectroscopy. Furthermore, the calcium binding ability of the dephosphorylated β -casein was measured against varying concentrations of calcium solution.

Key Words: β -Casein, Dephosphorylation, Characterization