the evolving recommendations being offered. Although, most modifications address a specific recommendation, other characteristics of the products may also be negatively altered. For example, should production systems be modified to increase the polyunsaturated fatty acids, conjugated linoleic acids (CLA), and omega-3 fatty acids and how will these changes affect shelf-life of the products? Should we attempt to decrease cholesterol content of animal foods? How can animal-derived foods be modified to contain greater concentrations of endogenous and of exogenous compounds to improve healthfulness of the resulting foods? Experiments that result in greater concentrations of polyunsaturated fatty acids including CLA and omega-3 acids and lesser total fat content in animal foods will be described. The influence of dietary fats and vitamin D on food quality, specific breeding programs, and molecular biological procedures that can be used to make specific changes in composition of animal foods will be described and specific examples will be given.

Key Words: Designer foods, Food quality, Fat composition

581 Designer foods: egg products. Hilary Shallo*, *Egg Nutrition Center*.

Last year, 158 million American - 85% – used a dietary supplement. Whether to simply maintain health or manage/treat a condition, nine out of ten shoppers prefer naturally nutritious foods to supplements (FMI/Prevention,1999; HealthFocus 1999). In its efficient ovoid container, eggs are naturally a functional food providing valuable nutrients, from their high-quality protein to significant levels of beneficial vitamins, antioxidants, and other healthful compounds. In addition to the eggs being a natural functional food, the egg's nutrient content can be altered by the feed given to chickens. Consumers can now find eggs with even less cholesterol and saturated fat than typical and with an added bonus of increased vitamin E and DHA. And processors are beginning to make similar products available on an industrial level. Dr. Hilary Shallo will discuss the new nutrient-enhanced egg products that are available in the marketplace.

Key Words: eggs, designer eggs

582 Dairy Foods and Ingredients - Nutritious and Functional Products for the Food Industry and the Consumer. P. Tong*[1] and C. Podgurski[1], [1]*Dairy Products Technology Center, California Polytechnic State University*.

Milk and the products made from milk are known to offer consumers good nutrition and good taste. Technologies continue to improve for the processing of milk into highly functional dairy ingredients for the food industry. In addition, consumer interest in health promoting foods is increasing. As a result dairy ingredients are widely used in formulating baked goods, nutritional beverages, confections, sauces and other foods for today's consumers. As our understanding of the biological function of individual milk components improves, a whole new line of bio-active, functional dairy foods and ingredients are emerging. These specialized dairy ingredients are being used in foods which are thought to improve overall health (e.g., immune function, intestinal health, blood pressure regulation, etc.).

Key Words: dairy foods, milk, nutrition

583 Product Overview: Meat Products. D. H. Beermann*, *University of Nebraska, Lincoln*.

Linkages between nutrients in foods and human health have long been used as a basis for dietary recommendations. The Dietary Guidelines and the Food Guide Pyramid provide guidance through identity of basic food groups and suggested relative daily intakes. Concerns about total fat, saturated fat, and cholesterol content of meat and meat products spurned suggestions in the 1980s and 1990s that intake of meat and meat products be reduced. Although these recommendations lacked credence because daily contributions to the diet relative to dietary guidelines were not described for meat and other foods, consumers responded to these suggestions. This prompted research investigations directed at discovering strategies or technologies that improve fat-to-lean ratio, fatty acid composition, and altered concentrations of other nutrients. Success in altering carcass and retail cut composition was achieved through genetic selection, genomic analysis, administration of metabolism modifiers (somatotropin, beta-adrenergic agonists, conjugated linoleic acid (CLA)) and improving diet formulations to more closely match nutrient requirements of livestock. Technologies were developed for reducing fat content and altering nutrient composition of manufactured meat products. Examples of these are discussed. The discovery of the anti-carcinogenic, anti-tumorogenic, anti-diabetic effects of the cis-9, trans-11 isomer of CLA led to investigations of strategies for elevation of CLA concentrations in lipid depots of meat animals, primarily through dietary manipulation strategies. Feeding full-fat extruded soybeans at a level of 25% of the diet increased CLA cis-9, trans-11 15 to 20% in steers, but in other studies, feeding 6% yellow grease doubled concentration of the isomer. Comparison of results of several unpublished studies is presented.

Key Words: Designer Meat, Fat, CLA

Contemporary Issues in Sheep Production and Research

584 Outlook for wool markets in the 21^{st} century. C. J. Lupton*, *Texas Agricultural Experiment Station, San Angelo*.

Wool's current market share of world fiber production is 3% with man-made fibers having 59% and cotton 38%. Raw material prices, processing costs, fashion trends, and fiber characteristics are all major factors in the global fiber competition for market share. In the past 15 yr, world production of wool has declined by 662 thousand tonnes from 3002 during the 1985/1986 season to 2340 in 1999/2000. During this time, production actually peaked at 3358 thousand tonnes in the 1990/1991 season. This high level of production, historically high prices, political and economic turmoil in the USSR and some eastern European countries, war in the Middle East, a drastic reduction in purchases by China, and the onset of recession in several major market countries combined to force suspension of the Australian Reserve Price Scheme in February, 1991, (a stabilizing factor on wool prices for the previous 17 yr). The concurrent accrual of a large wool stockpile (4.7 million bales in Australia alone) without price support resulted in an immediate downward adjustment in wool prices (35%). The effects of these events are still being felt. Slowly, the balance between supply and demand is being restored at price levels that will permit profitable production. Low prices have caused many producers to leave the sheep business. On the other hand, low prices have made wool more attractive to textile processors, and have helped wool retain some of its market share. Raw wool prices are now forecast to increase moderately over the next 10 yr because of lower supply, modest improvements in demand, and increasing numbers and affluence of consumers. In future, production and manufacturing is expected to be concentrated in those countries that can produce and process it at the lowest cost. The high standard and cost of living in the US, high labor costs, increasing land values, greater public concern for the environment and the well-being of wildlife including predators, the expectation of younger generations for more comfortable lives, and sheep's inability to adapt well to large-scale, indoor factory operations all lead me to believe a decreasing proportion of wool and lamb will be produced domestically. Imports will supply the predicted moderate increases in demand by U.S. consumers for wool and lamb.

Key Words: Wool, Wool Markets, Sheep

585 Current status of genomic tools for genetic improvement in sheep. B. A. Freking*, *USDA, ARS, U.S. Meat Animal Research Center, Clay Center, NE*.

Rapid accumulation of genomic sequence data from a variety of mammalian species has led to increased knowledge of the structural organization and function of genes which impact production traits in livestock species. Tremendous genetic variation exists within and between sheep breeds for many economically important traits. Identification of the specific allelic variation would allow efficient use of DNA-based technologies to enhance information used to predict breeding values. The existing genetic map based on microsatellites is useful for initial scans of the sheep genome, but lacks comparative information on positional candidate genes. Current efforts in gene discovery have generated substantial

numbers of expressed sequence tags (EST) for cattle and swine. Over 150,000 bovine and 50,000 porcine EST sequences are publicly available. The cDNA clones used to produce the EST sequences are also useful resources for the production of microarrays used to profile gene expression patterns. At MARC, primers designed to amplify genomic samples for mapping bovine and porcine EST sequences have also been successful in amplifying sheep DNA. To date, 276 bovine-derived and 128 porcine-derived EST primer pairs have generated sheep amplification products. Sequence variation between different animals in the form of single nucleotide polymorphisms (SNP) will be the future platform for high-throughput automated genotyping technologies and evaluation of marker associations of phenotypes and important genes. The sheep industry must focus on the relevant traits which improve the viability and efficiency of lean lamb production. Genomic tools are rapidly changing our ability to efficiently identify and utilize genetic variation.

Key Words: Sheep, Genetics, Genomics

586 Nutrient recommendations for sheep: gaps in information and future approaches. H.C. Freetly*, *USDA, ARS, Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE.*

Developing nutrient recommendations is an iterative process that involves taking available information, making a set of recommendations, testing the recommendations, and using the new information to refine the recommendations. The National Research Council last published its recommendations of sheep nutrient requirements in 1985. Given the elapsed time, the question has been raised, do those recommendations need to be refined? Changes in the demographics of the sheep industry have resulted in changes in the types of sheep raised and management used. These changes have resulted in some deficiencies in the previous recommendations. Recommendations for the growing lamb do not take into consideration 1) decreases in maintenance energy with increased age, 2) the effect of previous nutrition on subsequent performance, 3) breed type differences, or 4) defined amino acid utilization. Recommendations for the ewe do not take into account 1) dynamic changes in body weight, 2) dynamic adjustments for gestation and lactation, 3) large litter sizes, and 4) defined amino acid utilization. Using the existing equations to predict nutrient recommendations for large lambs and ewes results in extending the input data beyond that used to parameterize the equations. Recommendations for mature rams are absent. Since the last recommendations were developed, a sparse amount of research has been conducted that addresses these deficiencies. This paucity of available research suggests that major changes in the system would be difficult to make. The mathematical structure of the system will determine what research needs to be conducted. The current recommendations are mathematically based on a net energy system. Alternative model structures can be used to develop the future nutrient recommendations. A consensus on the structure of the next mathematical model will provide guidance to investigators in their experimental designs that will allow them to focus their resources on collecting the information required to parameterize the system.

Key Words: Sheep, Nutrition

Animal Production and the Environment: Challenges and Solutions

587 CNMPs, TMDLs, CAFOs/AFOs, effluent guidelines, and other issues. T. Hebert*[1], [1]*Capitolink, LLC.*

Livestock agriculture faces enormous challenges and opportunities that are driven by events and programs at both the federal and state levels. Most of these are directly related to proposed and coming changes in key water quality regulatory policies. These include proposed rules for permitting of Concentrated Animal Feeding Operations (CAFOs)and their related Effluent Limitation Guidelines, Comprehensive Nutrient Management Plans (CNMP's), the final rulemaking on Total Maximum Daily Loads (TMDL's). In addition, the farm bill is also in the process of being re-authorized, and a key item for consideration is potential funding to help livestock producers manage manures more effectively and to protect water quality. The status of these matters, the outlook for their final disposition, and some key implications for the livestock sector will be discussed.

Key Words: CAFO, CNMP, TMDL

588 Challenges and opportunities facing animal agriculture: Optimizing nutrient management in the atmosphere and biosphere of the earth. E. B. Cowling*[1], [1]*North Carolina State University.*

Humans need food. Humans use energy. Production of food and combustion of fossil fuels increase concentrations of biologically active N in the atmosphere, soils, and surface and ground waters of the earth. These increases are caused in part by demand for animal protein in human diets, increased use of synthetic N fertilizers, and widespread planting of N-fixing legumes. The world's crops, forests, and fisheries respond to N enrichment with some positive benefits (e.g., increased food, feed, timber, and fish production) and some negative consequences (e.g., acidification and euthtrophication of aquatic and terrestrial ecosystems, decreased biodiversity, increased regional haze, global warming, and such human health impacts as nitrate contamination of drinking water and increased pulmonary and cardiac disease caused by exposure to toxic ozone and fine particulate matter).
So far, most pollution abatement strategies have aimed at resolving one or another pollution problem in which oxidized or reduced forms of N play an important part. The time has come to consider more fully integrated strategies by which N management practices can be optimized to increase agricultural, forest, and fish production while decreasing N-induced soil-, air-, and water pollution.
The challenges and opportunities facing animal agriculture include joining with EPA, university, and other stakeholders in: 1) making realistic assessments of actual positive and negative impacts of N and particulate matter emissions from animal agriculture, and 2) developing practical (economic) guidelines and strategies for: a) minimizing use of fossil fuels in agriculture, b) improving feed conversion efficiency in poultry, egg, swine, cattle, and dairy production, c) conserving and reusing valuable nutrients in animal wastes, d) minimizing N and P losses from manures, e) developing horizontally and vertically integrated systems of meat production and manure management through production and marketing of high-return value-added products.

Key Words: Atmosphere, Biosphere, Nutrient Management

589 Animal production impacts on nitrogen emissions to air and ground water: a Dutch case with a European perspective. Wim de Vries*[1], Hans Kros[1], Oene Oenema[1], Gert Jan Reinds [1], and Max Posch[2], [1]*Alterra Green World Research, Wageningen, the Netherlands,* [2]*National Institute of Public health and the Environment, Bilthoven, the Nether.*

In the Netherlands, intensive animal husbandry has led to very high N emissions into the environment. The estimated total annual N input flux per hectare on agricultural land for the year 1997 is 485 kg for the Netherlands compared to 146 kg for the European Community. The animal manure production in the Netherlands is approximately 5 times the average European value (265 kg compared to 56 kg) and the same holds for the N surplus (256 kg compared to 52 kg).
To gain insight in the fate of N input in the Netherlands, a study was carried out analysing the nitrogen fluxes for 250 × 250 m2 grid cells with a simple N balance model representing all crucial processes in the N chain. Results of average annual fluxes (kton N.yr-1) for the year 1997 equalled 1077 for the total N input and 261 for the total N emission to air, ground water and surface water, i.e. 140 for NH3 emission, 103 for N leaching and 18 for runoff to the sea.
Despite the relative low N leaching and N runoff compared to the N input, it does cause an excess of critical limits for nitrate in ground water (50 mg.l-1) and nitrogen in surface water (2.2 mg.l-1) in large parts of the Netherlands. We calculated the maximum allowable nitrogen application on the basis of the critical limits given above and the acceptable ammonia emission related to the protection of biodiversity of natural areas. Results showed a reduction of 50 to 70% is needed to reach the ceilings necessary to protect the environment against all adverse impacts.
On a European scale NH3 emissions are the major cause of elevated N deposition. Results of atmospheric deposition measurements at 317 forested plots, mostly concentrated in central Europe, showed that more