Poster Session

The poster paper session occurred next from 3:00 PM to 4:00 PM. The poster papers remained on display for the rest of the conference. Papers displayed with authors present were:

Advantages of Pasture-based Milk Products

Authors: Van Hekken, D. L.[1] *, Tunick, M. H.[1] , and Tomasula, P.T.[2]*

[1]Research Chemists and [2]Research Leader, USDA-Agricultural Research Service, Dairy and Functional Foods Research Unit, Eastern Regional Research Center, Wyndmoor, PA 19038

Recent research has focused on determining the biologically active compounds naturally occurring in milk from pasture-fed cows and evaluating the impact of processing on these compounds. This research addresses one of the critical goals of the Northeast Pasture Consortium to "summarize conjugated linoleic acid (CLA) and human nutritional benefits present in grass-fed products".

Dairy products contain many biologically active compounds that can influence human health including the long-chain unsaturated fatty acids (FA's) such as CLA and omega-3 FA's; these are FA's that contain 18 carbons and double bonds. Because these healthy lipids have been linked to human health benefits, research to quantify these levels in milk produced using different farming systems is needed.

In our 3-year case study comparing milk from adjacent grass-fed organic and confined conventional dairies (minimizing regional and weather-related variations), we showed that the healthy lipids found in the milkfat were significantly higher in the milk from grass-fed cows (consuming over 50% of their daily dry matter intake as grass during the grazing season) compared to cows with no access to pasture. Increases in CLA (25-30%) and omega-3 FA's (36%), and the lowering of the ratio of omega-6:omega-3 were found in milk from grass-fed cows during the grazing season with omega-3 being higher throughout the year when compared to milk from the conventional herd.

The impact of processing protocol (homogenization, pasteurization, and sterilization) on the lipid profile of whole milk (standardized to 3.25% fat) was also conducted on milk collected from the two farms during the 3rd grazing season. The long-chained FA's, both unsaturated (CLA and omega-3 FA's) and saturated, were stable through the heat treatments, while homogenization tended to degrade the long-chained saturated FA's to shorter lengths. Therefore, the processed milk from the organic herd continued to have the higher levels CLA and omega-3s.

Our studies have shown that the most significant difference between our two herds is the higher levels of healthy lipids in milk from grass-fed organic herds. Therefore, milk from grass-fed herds should be incorporated into dairy products, such as specialty milk products and cheese, where the elevated levels of healthy lipids can aid in benefiting human health.

Effect of beet pulp or barley grain supplementation of a pasture-based diet on ruminal fermentation and methane output in continuous culture

Authors: Soder, Kathy[1] *, Aimee Hafla[1] (formerly USDA-ARS, now with Agri-King), Andre Brito[3], Melissa Rubano[1], and Curtis Dell[2]

[1]Animal Scientists and [2]Soil Scientist, USDA-Agricultural Research Service, Pasture Systems & Watershed Management Research Unit, University Park, PA 16802
[3]Assistant Professor, Dairy Nutrition Research Center, University of New Hampshire, Durham, NH

A 4-unit dual-flow continuous culture fermentor system was used to assess the effect of supplementing 2 levels (5 and 10% of diet DM) of starchy (barley grain: BAR) or fibrous (beet pulp: BP) carbohydrate (CHO) to an orchardgrass diet on nutrient digestibility, VFA production, bacterial protein synthesis, and methane output. Treatments were randomly assigned to fermentors in a 4 x 4 Latin square design with a 2 x 2 factorial arrangement using 7 d for diet adaptation and 3 d for sample collection. Treatments included: 1) 57 g DM herbage + 3 g DM BAR; 2) 54 g DM herbage + 6 g DM BAR; 3) 57 g DM herbage + 3 g DM BP; 4) 54 g DM herbage + 6 g DM BP. Feeding and pH sampling occurred at 0730, 1030, 1400 and 1900 h. Gas samples for methane analysis were collected at 0725, 0900, 1000, 1355, 1530, and 1630 h. Effluent samples were analyzed for OM, CP, NDF, nutrient digestibilities, estimation of bacterial protein synthesis, ammonia-N, and VFA. Data were analyzed using the MIXED procedure of SAS with period and treatment as fixed effects and fermentor as random effect. Orthogonal contrasts were tested for CHO type and level of supplement. No significant interactions were detected. Apparent and true OM digestibilities were not affected ($P > 0.10$) by CHO source (72.4 and 81.9%, respectively). True CP digestibility was greater ($P < 0.05$) for BP (75.3%) than BAR (52.5%) diets. Apparent NDF digestibility was lower ($P < 0.05$) for BP (79.5%) than BAR (85.1%) diets. Barley diets produced lower ($P < 0.05$) molar proportions of acetate (43.5 vs. 49.4 mol/100 mol, respectively), lower concentrations of total VFA (67.2 vs. 72.2 mmol/L, respectively) and tended ($P = 0.08$) to have greater mean pH (6.75 vs. 6.72) compared with BP diets. Methane production was not affected ($P > 0.10$) by CHO source. The 10% supplement produced greater ($P < 0.05$) concentrations of methane (35 vs. 27 mmol/d) and tended ($P = 0.07$) to increase apparent DM digestibility. Diet had no effect on bacterial efficiency. Supplementation of an herbage-based diet with BP improved CP digestibility compared with barley but did not affect OM digestibility, methane production, or microbial efficiency.

Keywords: Barley; Beet pulp; Methane; Ruminal fermentation

Long-Term Trends in Climate, Hydrology, And Water Quality In a Central Pennsylvania Watershed: More Grazing?

Authors: Kleinman, Peter J. A.[1]*, Haiming Lu[2], Kyle R. Elkin[3], Anthony R. Buda[4], Amy S. Collick[4], Gordon J. Folmar[5], and Ray B. Bryant[6]

[1]Research Leader & Soil Scientist, [3]Research Chemist, [4]Research Hydrologists, [5]Hydrologist, [6]Research Soil Scientist, USDA-ARS, Pasture Systems & Watershed Management Research Unit, Building 3702, Curtin Road, University Park, PA 16802, USA

[2]Nanjing Hydraulic Research Institute, State Key Laboratory of Hydrology-Water Resources and Hydraulic Engineering, 223 Guangzhou Road, Nanjing 210029, China

Adapting agriculture and water resource management to climate change requires local knowledge of what change is occurring. Long-term (1968-2012) temperature, precipitation and streamflow data from a small (7.3 km2) watershed in east-central Pennsylvania was used to examine climatic, hydrologic, and water quality trends in the context of recent climate change. Over the four decade period of observation, annual mean temperatures increased 0.38°C per decade, which led to increased evapotranspiration (+37.1 mm per decade). Although mean annual precipitation also increased, the overall

effect of higher evapotranspiration resulted in decreased streamflow. The lengths of warm season, growing season and summer season increased by 2.82, 2.83 and 4.00 days per decade respectively. The length of the cold season decreased at a fairly uniform rate of -0.74 days per decade, and the number of frost days also decreased at a rate of -3.64 days per decade. Seasonally, total precipitation during the growing season (mid-April to mid-October) was 34% higher than during non-growing season with June being the wettest and February being the driest months. Significantly wetter Octobers combined with the trend for later arrival of the first autumn freeze suggests opportunities for an extended fall grazing season on cool season grasses. The average length of periods of low streamflow, represented by the maximum consecutive days during which mean streamflow was lower than the 10th percentile, was 16 days and ranged from 0 to 70 days. This indicator of drought increased at an average rate of 1.9 days per decade over the study period. Hotter and drier summers suggest an opportunity for including warm season grasses in the grazing rotation. Nitrate losses decreased and phosphate losses increased in this predominantly row cropped landscape. In general, the findings suggest some challenges for producers and water resource managers with regards to increased rainfall and runoff. However, some changes such as an enhanced growing season can be viewed as a positive effect.

Management characteristics of grass-finished beef operations in Pennsylvania

Authors: Dillon, Jasmine[1]*, Al Rotz[2]

[1]Graduate Assistant, Animal Science Department, Penn State University, 324 Henning Building University Park, PA16802
[2]Agricultural Engineer, USDA-ARS Pastures Systems and Watershed Management Research Unit, University Park, PA 16802

The U.S. beef industry initiated a national sustainability assessment in 2011 to address concerns for the environmental, economic, and social sustainability of beef production. As a growing sector of the U.S. beef industry, grass-finished beef operations are being studied as part of this assessment. To achieve this goal, the industry is conducting an industry-wide life cycle assessment. Data on current beef production practices is being collected via surveys and farm visits across the country to inform the life cycle assessment. This assessment provides a means of benchmarking certain indicators of beef industry sustainability; it is not an attempt to compare one production system to another. The results provide a quantitative starting point from which each sector of the industry can improve its efficiency and sustainability. By collecting data at the farm level, the beef industry can begin to provide science-based answers to questions about its sustainability.

As a first step, a pilot study was conducted to collect data on production practices in Pennsylvania. Eighteen survey responses and four farm visits represented a total of 1,166 animals on 2,259 acres of land. The average farm had 22 cows, 1 bull, 6 replacement heifers, 15 stockers, and 13 finishing animals. The average total land use was 4.5 ac/cow, including the grazing and on-farm cropland required to maintain or produce feed for the herd.

Average mature cow weight was 1,232 lb, and calf weaning weight was 535 lbs. The time required to produce finished cattle ranged from 16 to 33 months with an average of 24 months. The average weight at finish was 1,097 lb with a range of 700 to 1,400 lb. Of the 18 farms that reported a known carcass dressing percentage, 44% reported being in the range of 55-60% and 33% reported being in the 60-65% range. Implants and other growth promoting technologies were not used.

Seventy-eight percent of the land represented in the survey was grazed by cattle with 94, 4, 1, and 1%

of those lands managed as perennial forage, annual forage, crop residue, and silvopasture, respectively. Cattle were grazed for 8 months of the year on average with responses ranging from 5 to 12 months. Twenty-three, 14, and 14% of farms reported using N, P, or K fertilizer, respectively, on pasture or (more commonly) annual crops grown to feed cattle. The primary form of fertilizer used was poultry manure. Sixty-eight percent of farms applied lime at some interval. Of the producers purchasing feed to maintain the herd (10 farms), an average of 0.8 tons of feed per animal was purchased. Dry hay and grass or alfalfa silage were the most commonly purchased feeds and grass and mixed grass-legume hay were the most common feeds produced on farm. Hay and/or silage was harvested on 55% of farms for winter feeding.

The data and information obtained from these farms will be used to develop representative operations for a life cycle assessment of grass-finished beef production in Pennsylvania.

Environmental footprints of grass-finished beef production in Pennsylvania

Authors: Dillon, Jasmine[1]*, Al Rotz[2]

[1]Graduate Assistant, Animal Science Department, Penn State University, 324 Henning Building University Park, PA16802
[2]Agricultural Engineer, USDA-ARS Pastures Systems and Watershed Management Research Unit, University Park, PA 16802

The U.S. Beef Industry initiated a national sustainability assessment in 2011 in an attempt to address concerns for the environmental, economic, and social sustainability of beef production. Representing a growing sector of the U.S. beef industry, grass-finished beef operations are being studied as part of this assessment. Beef operations are being surveyed and visited across the United States to collect information on current beef production practices. As the first step of this project, a pilot study in the fall of 2014 surveyed 21 farms and made site visits to four operations producing grass-finished cattle across Pennsylvania. Data related to animal, land, and feeding characteristics and management practices were collected.

Based on the data collected, six operations were modeled to represent the most common management practices employed by grass-finishing beef producers in Pennsylvania. The six operations represented cattle finished at a weight in the range of 1,150 to 1,250 lb at an age from 22 to 30 months. The following systems were modeled: (1) dry hay and alfalfa silage purchased to maintain the herd; (2) hay and silage produced from pastureland for livestock feed; (3) hay and silage produced on non-grazed cropland for livestock feed; (4) oats produced using poultry manure as a fertilizer for oat balage; (5) oats produced using synthetic P and K fertilizer for oat balage; and (6) fall rye grazed to extend the grazing season. The farms also differed in herd size and time to finish. All of the farms were assumed to manage cattle using some form of rotational grazing to achieve a 9 month grazing season. One bull per 25 cows was assumed, and an annual replacement rate of 20% was used. The soil texture for all farms was a shallow loam.

Farm-gate carbon footprints of the operations ranged from 15.4 to 18.2 lb CO_2e/lb BW produced, with the highest footprint for system 4 and the lowest footprint for system 2. All farms showed a positive carbon balance. Reactive nitrogen footprints on the operations ranged from 0.102 to 0.146 lb N loss/lb BW, with system 6 reflecting the highest footprint and system 2 showing the lowest. Water footprints with precipitation excluded were relatively small, ranging from 4.7 to 24.6 gal/lb BW. System 6 had the highest water footprint and system 3 had the lowest. Fossil energy use ranged from 12.7 to 24.6

MBtu/lb BW, with system 5 and system 2 having the highest and lowest footprints, respectively.

Whole farm nutrient balances varied among systems. Systems 1 and 4 showed long term buildup of phosphorus, while systems 2, 3, 5, and 6 showed long term depletion of phosphorus. Similarly, systems 1 and 6 showed long term potassium build up, whereas systems 2, 3, 4, and 5 showed long term potassium depletion. These findings have implications for future management of these systems, where sparing use of fertilizer or strategic crop rotation may reduce farm nutrient imbalances.

The farm-gate data and information obtained from simulating these representative operations are being used to complete a full life cycle assessment of grass-finished beef production in Pennsylvania.

Vermont and New York Energy Life Cycle Case Studies

Authors: Eric Garza[1], Jennifer Colby[2]*, Bob Parsons[3], Mark Cannella[4], Juan Alvez[2]

[1]University of Vermont Rubenstein School of Natural Resources and the Environment
[2]University of Vermont [Extension] Center for Sustainable Agriculture
[3]University of Vermont Extension and Community Development and Applied Economics Dept.
[4]University of Vermont Extension Farm Viability Program, Burlington, VT 05405

Data from the USDA suggests it requires at least 14 kilocalories of energy to produce, distribute and consume one kilocalorie of food once losses due to waste and spoilage are accounted for. Reducing the energy intensity of food production requires understanding how energy is used throughout food systems, including on farms. A better understanding of energy use enables the adoption of better management practices on a farm that can reduce energy inputs. A thorough energy audit includes two broad classes of energy use: direct and indirect. Direct energy use includes the energy contained in fuel purchased and used directly, including electricity, diesel, gasoline, heating fuels and biomass-derived fuels like wood or biodiesel. Indirect energy includes fuel used to manufacture direct fuels, vehicles, farm machinery, and built infrastructure such as buildings and roads, and it also includes that required to manufacture and deliver consumable inputs such as fertilizer, pesticides, compost, or other purchased items.

Monte Carlo simulation was used to assess how uncertainties in energy use estimates contribute to uncertainty in total farm energy intensity. The probability distributions for all variables were assumed to be normal. Direct energy inputs were assumed to have standard deviations of 10 percent of their means, while indirect energy estimates were assumed to have standard deviation that were one quarter of the difference between presented high and low estimates. The simulation was run 1000 times. All averages generated by Monte Carlo methods are presented as mean ± 2 standard deviations, which approximates a 95 percent confidence interval.

Energy audits were carried out on three grass-based farms; a New York farm raising dairy heifers, a Vermont dairy farm and a Vermont lamb farm.

In the case of the New York farm, data was gathered by survey on food production, fuel and labor use and infrastructure on the farm for the calendar year 2014. This farm receives 500-pound heifers and grazes them for a season to get them up to 900 pounds. The proprietors estimate their enterprise produced 26,320 pounds of body weight during the 2014 grazing season. The farm's 2012 operations required 80 ± 22 million kilocalories of direct and indirect energy inputs to deliver 7.6 ± 1.7 million kilocalories of meat. This translates to 11 ± 4 kilocalories of input energy to deliver one kilocalorie of boneless meat, nearly three times as high as the average of 4 kilocalories of energy input to produce 1 kilocalorie of boneless meat derived from USDA data. For this grass farm, direct energy represented roughly 30 percent of total energy use in 2014, while indirect energy makes up the remaining 70 percent.

The Vermont dairy farm's 2012 operations required 527 ± 226 million kilocalories of direct and indirect energy inputs to deliver 584 million kilocalories of fluid milk in 2012. This translates to 0.91 ± 0.22 kilocalories of input energy to deliver one kilocalorie of fluid milk. This estimate is less than half the 2.27 kilocalories of input energy required to deliver one kilocalorie of fluid milk on dairy farms throughout the United States. Direct energy use represented 31 percent of total energy use, while indirect energy makes up the remaining 69 percent.

The Vermont lamb farm's 2012 operations required 134 ± 13 million kcal's of direct and indirect energy inputs to deliver 14 million kcal's of lamb meat in 2012. This translates to 9.52 ± 1.30 kilocalories of input energy to deliver one kilocalorie of meat. This estimate is more than twice the input energy required to deliver one kilocalorie of meat. For this farm, direct energy use represented 52 percent of total energy use, while indirect energy makes up the remaining 48 percent.

* *Poster Paper Presenter*