

When considering *in vitro* or laboratory assays for predicting AA digestibility or protein quality of SBM, the urease assay is good for detecting underprocessing and the KOH protein solubility assay is good for detecting overprocessing. A combination of the latter two assays is needed to ensure that SBM has neither been underheated nor overheated. The protein dispersibility index (PDI) assay may be superior to the urease and KOH assays as an indicator of minimum adequate heat processing of SBM. Determining the Lys concentration as a percentage of the CP may be a good initial indicator of possible overprocessing. Recent work indicates that near infrared reflectance spectroscopy (NIRS) and a new immobilized digestive enzyme assay (IDEA) may also be useful assays for predicting *in vivo* AA digestibility of SBM.

Key Words: Soybean meal, Amino acid digestibility, Poultry

859 Soybean meal quality:swine industry perspective. Keith Haydon*¹, ¹*Heartland Pork Enterprises, Inc.*

Soybean meal (SBM) in swine nutrition has long been the "gold-standard" protein that all other competitive proteins are measured and priced against. SBM provides an excellent amino acid (AA) profile of high true digestibility relative to the pigs' requirement when balanced with corn in a complete feed. The quantity and availability of energy, essential amino acids (EAA) and phosphorous (P) primarily drive SBM quality in the context of swine nutrition. Since energy is the most costly nutrient in swine feeds, the energy value of SBM is critical in formulating

cost efficient diets that provide optimum growth with minimal nutrient excretion and/or energetic losses. Dehulled SBM contains (by difference) approximately 32 to 35% carbohydrates in primarily oligosaccharide forms. Improvement in the digestibility of these components offers tremendous potential in improving the available energy in SBM. Defining the factors that can influence or that can improve the energy value of SBM is paramount to swine nutritionists. Considerable time and effort has been spent over the past 84 years in understanding the impact of required heat treatment of soybeans to neutralize the inherent anti-nutritional factors and their impact on AA availability. The use of protein dispersibility index alone or in conjunction with KOH protein solubility test provides an excellent means to predict adequacy of heat treatment during processing, but are not practical for use in large scale feed mills. Most swine nutritionists surveyed by the author routinely monitor moisture, protein and fiber in SBM. Many have AA analyses performed for quarterly or monthly baselines or predict AA levels from protein levels; however, rarely would they modify their matrix digestibility values based on compositional changes. Increasing the P availability in SBM could decrease diet cost and P excretion and increase dietary energy concentration. Many swine nutritionists consider SBM one of the most consistent quality (nutrient composition and availability) ingredients they use. Areas of concern or opportunity to improve SBM are energy value, consistent processing methodology across the industry and increased P availability.

Key Words: Soybean meal , swine, industry

Twinning Beef Cows

860 Experiences and management of twinner cattle. D. O'Kief*, *O'Kief Ranch, Wood Lake, NE.*

After graduation from the University of Nebraska at Lincoln and before returning to ranching at Wood Lake, NE, Dan O'Kief put his knowledge of reproduction in cattle to work managing Twinner cattle at the United States Meat Animal Research Center at Clay Center, Nebraska. In this symposium on twinning beef cows, Dan will discuss three primary areas related to twinning cow management. These include:

1. The critical period from calving to day three.
2. Improvement of reproductive management of twinning cows.
3. Meeting the mineral and energy demands of twinning cows.

Key Words: Cattle, Twinning, Management

861 Summary of the MARC genetics program to produce twinner cows. R. M. Thallman* and K. E. Gregory, *USDA/ARS, U.S. Meat Animal Research Center, Clay Center, NE.*

The U.S. Meat Animal Research Center (MARC) initiated a program to select cows for increased twinning rate in 1981. Cows that had produced multiple sets of twins were purchased from commercial producers (96 cows) or were transferred from other projects at MARC (211 cows). Semen from 8 Swedish Friesian and 7 Norwegian Red bulls whose daughters twinned more often than normal was imported. Other foundation sires included sons of foundation cows and one Pinzgauer and one Charolais bull whose daughters twinned at high rates in another project at MARC. The herd is 24% Pinzgauer, 18% Simmental, 17% Holstein, 14% Swedish Friesian, 9% Hereford and Angus, 10% Norwegian Red, and 8% other breeds. Current herd size is 300 cows, half calving in spring and half in the fall. Twinning rate (TR) currently averages 50%. Ovulation rate (OR) is used as an indicator trait and is measured by counting corpora lutea via rectal palpation over six to eight estrus cycles prior to breeding heifers for the first time to calve at 30 months of age. The heritabilities of TR and OR are 0.09 and 0.10, respectively, with a genetic correlation of 0.75. Predicted breeding values (PBVs) are computed using a multiple trait, repeated records model for TR and OR. Approximately 10 young bulls are progeny tested per year. Following measurement of their daughters' OR, the best sires are mated to females with the highest PBVs to produce candidates for progeny testing. Response to selection for TR has averaged 2.5% per year. Tissue samples for DNA have been obtained from animals in the herd in 1994 and thereafter. In addition, semen samples were available from most of the sires used prior to 1994. Two quantitative trait loci (QTL) for TR and OR have been identified on chromosome 7 (approximately 60 cM apart) and one on chromosome 5. These three QTL account for about 15% of the genetic variance and are used together with residual polygenic effects in a two-trait model

to compute marker adjusted PBVs, which have been used since 1998. Selection for TR has been effective, in spite of low heritability.

Key Words: Twins, Beef, Genetics

862 Reproductive, growth, feedlot, and carcass traits of twin versus single births in cattle. S. E. Echtenkamp* and K. E. Gregory, *USDA, ARS, RLH US Meat Animal Research Center.*

The production of fraternal twin calves presents a new paradigm in beef cattle management and production and affords an opportunity to increase both reproductive and economic efficiency. The first prerequisite for fraternal twins is twin ovulations. Breeding value for twinning was predicted by repeated measures of ovulation rate in yearling heifers and of twinning rate in the selected herd at the U. S. Meat Animal Research Center. Twinning rate increased 3% per year to an annual rate of 50 to 55%. Gestation length was shorter (275.6 vs 281.3 d; $P < 0.01$) and birth wt was smaller (38.2 vs 47.0 kg; $P < 0.01$) for twin vs single calves, respectively, but total birth wt (live) was increased 53.1% for twins. Respective weaning wt (200-d wt) were 231 vs 259 kg ($P < 0.01$). Number of calves weaned per cow calving was 0.92 for single vs 1.52 for twin births ($P < 0.01$); thus, total weaning wt was increased 47.4% for twins. Single male calves gained 74 g more per d than twin males from birth to 200 d, and 45 g more per d from 200 d to slaughter. Differences in carcass traits between twin and single males were small. Freemartins, 96% of the females born co-twin to a male, did not differ from normal females in growth traits, but freemartins had higher ($P < 0.05$) scores for marbling and a higher ($P < 0.05$) percentage of carcasses were USDA Choice or higher quality grade. Efficiency constraints to twins were increased ($P < 0.01$) incidence of retained placentae (28.0% vs 1.9%), of dystocia (46.9% vs 20.6%) and of perinatal calf mortality (16.5% vs 3.5%); difference in calf survival at 200 d was 14.3%. Dystocia of twins resulted primarily from malpresentation of one or both calves. Fertility was reduced 11.6% ($P < 0.01$) after a twin birth and 9.5% ($P = 0.06$) after a retained placenta, but the effect of twinning on fertility varied significantly ($P < 0.01$) among years and seasons. Collectively, twinning increased productivity at weaning by 54.2 kg or 28.3% per cow exposed at breeding.

Key Words: Twinning, Production, Cattle

863 Management of twinning cow herds. B.W. Kirkpatrick*, *University of Wisconsin-Madison.*

Many beef producers oppose twin birth for the perceived detriments associated with the trait. These include lower calf survival, increased dystocia (malpresentation), increased stillbirth, increased abortion, calf abandonment, retained placenta, lengthened interval from parturition to conception and freemartin heifers when born co-twin with a male. Some of these problems can be overcome with changes in management, others lack an obvious management fix and still others are of little practical significance. Management alterations which may be required for successful exploitation of twin birth include (1) pregnancy checks to determine twin versus single pregnancy, (2) adequate calving facilities and (3) early calf weaning. Determining whether a cow is pregnant with twins eliminates surprises at calving time in that cows at high risk for malpresentation are identified beforehand. In addition, cows gestating twins could be fed a higher plane of nutrition in recognition of the higher demands on them both during late gestation and subsequently while nursing twins. Adequate calving facilities are a necessity given the significant fraction of twin births which are malpresentations. Additionally, availability of calving pens facilities penning of cows with their twins which is sometimes needed to address potential calf abandonment problems. Early weaning is well documented to have beneficial effects on postpartum reproductive performance. Given the typically longer interval from parturition to conception for twin bearing cows, early calf weaning may help maintain adequate reproductive performance. Considering the remaining problems, there are no obvious alterations of management which will improve twinning-related problems with stillbirth, abortion or retained placenta. Freemartinism falls into the last category of something which is more a perceived than real problem. Given that absolute number of fertile females produced from a twinning system will differ little from a single-birth system, freemartinism is not a serious drawback of twinning in beef cattle.

Key Words: Twinning, Cattle, Management

864 Comparison of the profitability of single-calf with twinning cow herds. M. L. Thonney*, *Cornell University, Ithaca, NY.*

A spreadsheet available at <http://www.ansci.cornell.edu/courses/as360/lab/budget.htm> was developed to compare the profitability of cow

herds on 202 hectares (500 acres) of moderately productive forage land with three levels of twinning (1%, 50%, 90%) with or without 2 kg supplement (\$0.12/kg) for 90 days in early lactation expected to maintain fertility in cows with twins to the same level as cows with singles. Purchased hay was priced at \$0.07/kg and extra hay was sold at \$0.06/kg. Land was valued at \$741 per hectare (\$300/acre) and there were about \$62,736 of other capital items. Calf and replacement numbers were determined by twinning rate, fertility, and death rates. Carrying capacity was determined by monthly pasture and hay field productivity and energy requirements of cows with a 10% increase for twinning cows supplied by increased forage or mostly by the supplemental grain mix during early lactation. Cash expenses per cow included extra vet supplies and labor for calving twinning cows which increased as percentage of twinning cows increased (Table). All assets were assumed to be 100% owned. Net farm income accounted for \$8,115 depreciation as well as cash expenses and increased (Table) over single calf herds by 32 and 60% for 50 and 90% nonsupplemented twinning herds and by 61 and 113% for supplemented herds. After accounting for \$3,500 of unpaid family labor and about \$28,600 for possible return on equity, return to operator's labor and management ranged from a loss of \$8,946 for a single-calf herd with 1% twins to a gain of \$17,706 for a supplemented herd with 90% twins. These results show that properly managed twinning cow herds could significantly increase profitability over traditional single-calf cow herds.

Percentage of cows twinning (supplement?):	1 (no)	50 (no)	90 (no)	50 (yes)	90 (yes)
Cows	100	95	91	99	98
Open cows, %	5	10.5	14.9	5	5
Calf loss, %	3.8	11.8	15.8	12.2	15.8
Calves per cow	0.8	1.1	1.3	1.2	1.5
Replacements	15	20	23	16	16
Cash expenses, \$	19,802	21,607	22,137	22,429	23,522
Net farm income, \$	23,411	30,860	37,519	37,768	49,872

Key Words: Cattle, Twinning, Economics

ASAS Horse Species: Historical Aspects of Equine Research—How We Got Here and Where Are We Going?

865 Historical aspects of equine nutrition. H.F. Hintz*¹, ¹*Cornell University.*

The modern horse was introduced to the North American continent in 1519. During the late 1800's and early 1900's a significant number of basic and applied studies were conducted on horse nutrition. Horse research was conducted at many experiment stations and even in territories such as Utah before they became states. However as the number of horses declined, research declined. By 1950, there were no research units at experiment stations dedicated to horse nutrition. As the popularity of horses increased in the 1960's nutrition units were established at several universities including the University of Florida, Texas A&M, University of Kentucky, Cornell University, and University of Minnesota. Research efforts have continued to grow, though not as great as some would like, and it appears the importance of the horse will continue to deserve research support.

Key Words: horse, nutrition, history

866 Effect of fasting on blood lipid concentrations in horses. N Frank*, J Sojka, and M Latour, *Purdue University, West Lafayette, Indiana.*

Triglyceride (TG) is exported from the liver in the form of very low-density lipoproteins (VLDL). This study examined the effect of fasting on plasma lipids, specifically VLDL. Four horses aged 13.5 + 3.9 yr were fasted or fed mixed grass hay (2.1% fat DM) *ad libitum* for a 36 h period beginning at 0800. Each horse served as its own control with a 7 d interval between study periods. Blood samples were collected every 2 h and plasma isolated. A density < 1.006 g/mL plasma fraction containing VLDL (and potentially chylomicron lipoproteins in fed horses) was

separated from plasma by ultracentrifugation. Components of VLDL including TG, total cholesterol (TC), free cholesterol, phospholipid (PL), and protein (PRO) were quantified. Plasma TG, TC, glucose, and NEFA concentrations were also measured. Total VLDL concentration was calculated by summing TG, TC, PL, and PRO concentrations. Repeated measures analysis revealed that fasting had a significant ($P < 0.10$) effect on VLDL concentration over time. Compared with fed horses, mean VLDL concentration was higher in fasted horses at 16 h and means differed significantly ($P < 0.05$) by 36 h. However, individual variation was observed. Fasting induced significantly higher VLDL concentrations in only two of the four horses. The percentage of TG in VLDL increased significantly ($P < 0.10$) with time in fasted horses. Plasma NEFA concentrations were significantly higher ($P < 0.001$) in fasted versus fed horses with mean (SE) concentrations of 299.9 (19.9) $\mu\text{mol/L}$ and 46.4 (2.1) $\mu\text{mol/L}$, respectively. Plasma TG, TC, and glucose concentrations did not differ significantly between groups. Results indicate that lipid-rich VLDL particles accumulate in the circulation of fasted horses, either as a result of accelerated secretion or inhibited clearance. Further studies are required to determine why individual horses respond differently to fasting. Potential contributing factors include body composition, endocrine status, genetic predisposition, and stress tolerance.

Key Words: Fasting, Lipids, VLDL

867 Plasma glucose responses of growing horses to different concentrate feeds. A. C. St. Lawrence*¹, L. M. Lawrence¹, S. H. Hayes¹, and M. Adams², ¹*University of Kentucky, Lexington, KY,* ²*Cooperative Research Farms, Guelph, ON.*

Fourteen horses (9 mos) were used to determine the effects of two concentrate feeds on glucose response to a meal. Initially, all horses received