

ing season, maturity and type of fermentation undergone by the plant material. Starch content of corn silage will be 25 to 40% on a DM basis; 2. Starch content of alfalfa hay or silage is low, less than 5% but the sugar content of alfalfa is variable and influenced by growing season, moisture, sunlight, and plant maturity. Alfalfa hay grown in the western U.S. routinely contains 5 to 9% sugar on a DM basis; 3. It is necessary to assay citrus pulp, beet pulp, distiller's grain, bakery meal and corn gluten feed because of variability in starch and sugar content. The rumen ecosystem does not always respond positively to extra starch or sugar in the diet. This ecosystem will respond positively when ruminal conditions favor the use of starch and sugar for growth of rumen bacteria and yeasts. Physical factors of the diet will influence response to starch or sugar. In diets with less than 27% NDF, and small particle size, increasing dietary sugar concentration to 5%- 6% diet DM may not increase feed intake and milk production. Excess starch can reduce the ME and MP of a diet because of inefficient energy use by rumen bacteria and a decrease in NDF digestion (Russell, 2002). Starch and sugar analyses are useful in dairy ration formulation because starch and sugar alter rumen microbial population and growth and impact ME and MP predictions.

#### References:

Russell, J.B. 2002. Rumen Microbiology and Its Role in Ruminant Nutrition, Cornell University, Ithaca, NY

**Key Words:** Starch, Sugar, Dairy

#### 537 NDF digestibility: conceptual and analytical challenges. M. S. Allen\*, Michigan State University, East Lansing.

Demonstration of the beneficial effects of NDF digestibility on feed intake and milk yield has created demand for analytical services by forage testing laboratories and for recommendations for utilizing NDF digestibility information. Variation in the methods used and proficiency at determining NDF digestibility across laboratories limit successful application of NDF digestibility information. Laboratories should provide information regarding intra- and inter-assay variation and validation of their method by showing relationships between NDF digestibility and lignin concentration as a percent of NDF (generally  $r \geq 0.7$  within forage type). Analytical methods should identify limitations to NDF digestibility inherent in the feed rather than those imposed by the method which will compress differences among feeds. Grinding is necessary to increase surface area of potentially fermentable fiber exposed by chewing in vivo but it overestimates rate of digestion because the increase in surface area is at the beginning of fermentation rather than gradually over time. Incubation time should reflect residence time in the rumen, which is inversely related to feed intake,

but shortened to account for effect of grinding on rate of digestion. It is unrealistic to use laboratory NDF digestibility values to adjust energy content of feeds because digestion characteristics of feeds affect retention time in the rumen and feed intake response. Feed intake response to forages with greater in vitro NDF digestibility is positively related to milk yield across cows and affects the relationship between in vitro and in vivo NDF digestibility. Comparisons of NDF digestibility across forages should be limited to within forage type; retention times for perennial grasses are generally greater than for legumes. Laboratory NDF digestibility values are best used as an index of filling effect of NDF and forages with high NDF digestibility should be targeted to cows with high milk yield for which feed intake is most limited by physical fill.

**Key Words:** NDF Digestibility, Dairy Cows, Physical Fill

#### 538 Collecting, interpreting and using corn silage NDF digestibility data as a consulting nutritionist for commercial dairies. W. Nelson\*<sup>1</sup>, C. Renken<sup>1</sup>, C. Holtz<sup>3</sup>, and B. Kloss<sup>2</sup>, <sup>1</sup>Nelson Dairy Consultants, Inc., Lakeville, MN, <sup>2</sup>Nelson-Kloss Dairy Production Nutrition, LLC, Visalia, CA, <sup>3</sup>Holtz-Nelson Dairy Consultants, LLC, Dryden, NY.

Corn silage has become the primary source of NDF in the diets of lactating cows throughout most of the United States. Our group of 25 nutrition consultants in the Upper Midwest, Central California, and New York State has been using corn silage NDF digestibility analyses to help consultants and clients for 6 years. I will explain the origin of our desire for analytical insight on corn silage fiber beyond that of traditional analysis packages. All data and discussion of samples, rations and cow responses originate from commercial dairies. Corn silage sample data will be presented comparing 20, 30 and 48-hour incubation times involving three different commercial laboratories over six years. Discussion will emphasize apparent shortcomings of traditional fiber analyses as well as shortcomings of the nutritional and agronomic conclusions derived from traditional analyses. I will share my experiences on the extent to which dairy producers and/or their contract growers are responding to the information provided by NDF digestibility analysis of corn silage and how they are or are not pursuing improvements in corn silage NDF digestibility from year to year. We are convinced that corn silage NDF digestibility is and will continue to be of primary importance to both nutritionists and dairy producers. Our group continues to pursue ways to better analyze and incorporate the added information that corn silage NDF digestibility data bring to the table when planning and formulating diets for commercial dairies.

**Acknowledgements:** All of our clients and consultants who participated, Dairy One Laboratory, Dairyland Laboratories, Cumberland Valley Laboratory

**Key Words:** Forage Quality, NDF Digestibility, Corn Silage

## Animal Behavior and Well-being: Weaning and Animal Welfare

#### 539 Effect maze task on salivary cortisol of pigs at weaning and on subsequent fear response. J. Siegford\*, G. Rucker, and A. Zanella, Michigan State University, East Lansing.

Learning, memory and regulation of the stress response are mediated by the hippocampus. Biologically relevant hippocampal-dependent tasks that develop and integrate cognitive processing of this region may not be available to piglets in some current production systems. We measured the effects of a hippocampal-dependent maze task (MT) on the stress response at weaning (12 days of age) and subsequent fear response (at 50 days of age). Twenty-seven pigs from 4 litters were assigned to one of 3 treatments: hippocampal enhancement (HE), isolation control (IC), or control with sow (CS), then combined into same sex groups with each treatment represented. Each group worked 4 times per day in the morning, with 10 minutes between sessions from 5-11 days of age. Prior to the start of work, groups were removed from the sow for 30 seconds. HE animals navigated the MT to return to sow and litter. IC were isolated while HE navigated the MT. CS were returned to sow as HE entered the MT. Data were analyzed with mixed model repeated measures analyses of variance, and

Bonferroni tests revealed differences in multiple comparisons. Saliva was collected immediately pre- and post-MT on day 11 to measure cortisol, which were lower pre-MT ( $F(1,8)=5.65, P=0.04$ ). Weaning at 12 days of age increased cortisol levels 2h post-weaning ( $F(4,75)=5.67, P<0.001$ ). On day 14 male IC pigs were slower than others ( $F(2,21)=3.09, P=0.07$ ) to solve a modified Morris water maze (WM), examining spatial learning. Lower cortisol levels were seen pre-WM versus post-WM ( $F(1,19)=27.62, P<0.001$ ). At 50 days of age, fear response of pigs was examined in 3 open field tests (OF: 1=alone, 2=w/ball, 3=w/person) consisting of 1 m acclimation and 4 m testing. Animals spent more time in OF center in OF3 than OF1 ( $F(2,75)=8.75, P<0.001$ ) and time spent in OF periphery was greater in IC in OF1 than in IC or HE in OF3 ( $F(2,75)=4.18, P=0.02$ ). In OF3, HE touched the person more times than other groups ( $F(2,49)=6.31, P=0.008$ ). MT may result in less fear of novel persons and places suggesting benefits of hippocampal activation for young pigs.

**Acknowledgements:** USDA NRI #2001-02440 to AJ Zanella.

**Key Words:** Spatial Memory, Open Field, Stress Response

**540 Odor preference of pre-weaning piglets to biologically relevant and non-relevant odors.** N. Krebs\* and J. McGlone, *Texas Tech University, Lubbock.*

The sense of smell is highly developed in pigs and could reduce weaning stress. To determine which odors were attractive, piglets were separated from their mother, grouped and exposed to different odors for 24 h and weight loss was measured over the same period. Two separately ventilated rooms (with 2 pens each) were used to test a single odor per room per block. A wick soaked with a single odor was placed in the back of the feeder so that the fan blew the odor from the wick through the feeder at piglet's height in the pen. Enough liquid was provided that the wick was soaked by capillarity for 24h. The air movements in the room were symmetrical to avoid pig preference for parts of the pen. In each experimental unit (total 43, average 4 replications/odor), four 15-to-20-d old pigs (2 males and 2 females) from four litters were put in a pen. Treatments randomly assigned to one side of the pen were: amyl acetate (AA), n-butanol (n-BUT), ammonia (NH<sub>3</sub>), phosphate buffered saline (PBS), maternal feces (FECES), maternal pheromone Suiience (MPH), androstenone (ANDRO), isopropyl alcohol (IA), lactose (LACT) and milk replacer (MILK). The position of the pigs was observed continuously for 24 h and a preference index (PI) was calculated for each treatment (=time spent in the half of the pen closer to the odor/total time). Pigs had a preference (PI > 50%) (P < 0.0001) for ANDRO compared to FECES (73.16% + 9.92 vs 45.88% + 7.50). There were no significant differences in PI among other treatments. Pigs significantly preferred (P < 0.001) at multiple hours for ANDRO, NH<sub>3</sub>, and n-BUT. The PI was not significantly different (P > 0.10) from 50% at any time for PBS, MPH, LACT, MILK, or FECES. Pigs lost less (P < 0.05) weight over 24 h when exposed to NH<sub>3</sub> than PBS (-.245 vs -.158 ± 0.027 kg). In conclusion, according to these preliminary data, newly weaned piglets spent more time near ANDRO. Piglets were attracted at times of the day to NH<sub>3</sub> and n-BUT. Odors can be used to direct the behavior of weaned pigs and might be used as a tool to improve performance.

**Key Words:** Pigs, Odors, Weaning

**541 Performance and behavior of calves reared in groups or individually following an accelerated-growth feeding program.** M. Terre\*<sup>1</sup>, A. Bach<sup>2,1</sup>, and M. Devant<sup>1</sup>, <sup>1</sup>Unitat de Remugants-IRTA (Institut de Recerca i Tecnologia Agroalimentàries), Barcelona, Spain, <sup>2</sup>ICREA (Institut Catalana de Recerca i Estudis Avançats), Barcelona, Spain.

Nineteen calves were reared in individual pens (IP), and 20 calves were grouped in 4 pens of 5 calves each (GP) to study the effects of rearing calves in groups or individually on behavior and performance. All calves were on an accelerated-growth feeding program and had unlimited access to starter. Total DMI, BW, serum urea, NEFA and glucose concentrations, and immune response to vaccination were measured. Also, behavior was monitored by continuous recordings of 20 min twice weekly following the morning and afternoon milk replacer consumption. After weaning, the observations were conducted at the same time as in the preweaning period (0730 and 1730). Behavior patterns were categorized in: non-nutritive sucking, cross-sucking, inter-sucking, and self-grooming. Performance and serum data were analyzed using a mixed-effects model

**543 Assessment of Antibiotic Usage in Dairy Herds in Pennsylvania.** A. Sawant\*, L. Sordillo, and B. Jayarao, *Pennsylvania State University, University Park.*

A survey of 113 dairy herds from 13 counties in Pennsylvania indicated that fifty percent of dairy farms maintained antibiotic treatment records. Only 21% had written plans for treating sick animals. Antibiotics were mostly administered (93%) by the owner/manager or designated herdsman, but only 32% of

with repeated measures. Behavior differences between and within treatments before and after weaning were assessed with a Mann-Whitney test and a Wilcoxon test, respectively. There were no differences in final BW and total DMI between treatments. The decrease of ADG during the week following weaning was more pronounced (P < 0.05) in GP than in IP calves. Serum NEFA concentrations tended (P = 0.06) to increase the week after weaning in GP calves. Serum urea concentrations were greater (P < 0.05) in GP than in IP calves 1 wk before (21.3 vs 16.6 mg/dL, respectively) and after weaning (27.2 vs 16.0 mg/dL, respectively). After weaning, non-nutritive behaviors increased (P < 0.05) in both treatments, but GP calves increased (P < 0.01) self-grooming behavior and decreased (P < 0.001) cross-sucking and inter-sucking behaviors. Positive immune response 3 wk after vaccination tended (P = 0.08) to be greater in IP (84%) than in GP calves (55%). Calves housed in groups struggled more at weaning, and appeared to mobilize more body reserves and have a slower immune response than calves housed individually.

**Key Words:** Calves, Behavior, Growth

**542 Weaning cattle in two stages reduces the behavior changes typically associated with weaning stress.** D. B. Haley\*<sup>1,2</sup> and J. M. Stookey<sup>1</sup>, <sup>1</sup>Western College of Veterinary Medicine, Saskatoon, SK, Canada, <sup>2</sup>Alberta Agriculture, Food & Rural Development, Red Deer, AB, Canada.

Our objective was to evaluate a novel two-stage weaning procedure against the traditional method of abrupt weaning. Pairs weaned in two stages were prevented from nursing (stage 1) for either 8 d (n=6) or 4 d (n=6) prior to physical separation (stage 2). Anti-sucking devices worn by calves prevented nursing. Control calves (n=6) nursed until they were abruptly weaned by separation. Behavior was recorded for 4 d prior to initiating the two-stage treatment, on all 4 d that two-stage pairs were prevented from nursing, and for 4 d following cow-calf separation. Activity was recorded directly by instantaneous sampling every individual animal at 10-min intervals, from 0700 to 1900 h. Also, for 2 min during each 10-min interval, we recorded the number of vocalizations by individual animals. The mean values below (calls/h, min/d) were calculated to represent the entire 12-h observation period based on results from interval sampling. The two-stage treatments produced similar results whether nursing was prevented for 8 or 4 d. Both groups showed a reduced behavior response to weaning compared to controls. When nursing was prevented, two-stage animals were more vocal than controls, but treatment differences may be of questionable biological significance (two-stage treatments combined vs. controls: cows=5.1 vs. 0.6 calls/h, P<0.01; calves=1.5 vs. 0.1 calls/h, P<0.001). Compared to controls, following separation, two-stage cows called 84% less (14.3 vs. 89.4 calls/h, P<0.0001), spent 60% less time walking (28.5 vs. 70.8 min/d, P<0.001) and 13% more time lying (165.2 vs. 146.3 min/d, P<0.05). After separation, compared to controls, two-stage calves called 97% less (1.9 vs. 56.0 calls/h, P<0.0001), and spent 30% more time eating (267.9 vs. 206.3 min/d, P<0.01). Use of the anti-suckling device for 4 d prior to physical separation offers a practical solution to reducing the signs of distress shown by cattle when they are weaned abruptly. Benefits of this procedure such as reduced calling, reduced walking, and increased time spent eating can be achieved simply by preventing nursing between cows and calves for 4 d, before separating them.

**Key Words:** Beef Cattle, Weaning Stress, Behavior

## Animal Health II

farms sought a veterinarian's advice before administration. Only 24% of dairy producers followed label instructions. The majority of dairy producers used extralabeled antibiotics, with guidelines from a veterinarian; separated and visibly marked treated cows; and milked treated cows last with a separate milking unit. Records of 33 farms indicated that the most common conditions were pneumonia and enteritis in calves; mastitis, metritis, and foot rot and in cows; and mastitis and pneumonia in dry cows. Antibiotics were mostly used for treating