Forages and Pastures: Composition and Quality

663 Ruminal and post ruminal crude protein digestion of halophyte forages (*Kochia scoparia*, *Atriplex domorphostegia*) determined by various procedures. A. Riasi*[1], M. Stern[2], M. Danesh Mesgaran[1], and M. Ruiz Moreno[2], [1]*University of Mashhad*, *Mashhad, Khorasan, Iran*, [2]*University of Minnesota*, *St. Paul*.

Ruminal, post-ruminal and total tract crude protein (CP) digestion of two low-quality forages originating from central Iranian deserts (*Kochia scoparia*, *Atriplex domorphostegia*) were evaluated using in situ, three-step and Daisy^{II} incubator procedures. These forages are halophytic plants typically grown on salty land that are a significant part of the local flora in central Iran. During unfavorable environmental conditions, these forages can provide supplemental or emergency feed for ruminants. Linear regression equations were used between the three-step and Daisy^{II} incubator procedures to determine if there was a relationship between procedures. Results showed that ruminal CP disappearance of Kochia was lower ($P < 0.05$) than Atriplex after 12 h incubation in the rumen, but there was no difference ($P > 0.05$) between forages after 16 h incubation. Post-ruminal CP digestion was not different between Kochia and Atriplex when using the three-step procedure (33.0 and 35.0 %, respectively) or the Daisy^{II} procedure (58.0 and 60.0, respectively). Total tract CP digestion of Kochia (86.6 %) tended ($P < 0.1$) to be lower than Atriplex (88.6 %) when using the three-step procedure, while total tract CP digestion of Kochia (88.4%) and Atriplex (91.3%) differed ($P < 0.05$) when using the Daisy^{II} procedure. Coefficients of determination (r^2) for the relationship of ruminal, post-ruminal and total tract CP digestion between the three-step and Daisy^{II} procedures were 0.70, 0.65 and 0.80, respectively. Results showed that there was a good relationship between the procedures for evaluating CP digestion of halophyte forages.

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Key Words: Low-Quality Forages, Three-Sstep, Daisy^{II} Incubator

664 Factors affecting the quality of corn silage grown in hot, humid areas 1: Effect of delayed sealing, simulated rainfall and ensiling temperature. A. Adesogan*[1] and S. Kim[1,2], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *South Korea*.

This study aimed to determine how simulated rainfall, delayed sealing and high ensiling temperatures affect the fermentation and aerobic stability of corn silage. Half of each of four, replicated, 6 x 1.5 m plots of a corn hybrid were harvested at 350 g DM /kg. The remaining half was harvested after it was sprinkled with sufficient water to simulate 4 mm of rainfall. The forage samples were either ensiled (2 kg) immediately in a plastic bag in quadruplicate, or after a 3 h wilt. Half of the bags were stored in a 30°C incubator and the other half in a 40°C, air conditioned room. After 82 d, of ensiling, the bag silos were opened and the silages were chemically characterized. A 2 (moisture treatments) x 2 (sealing times) x 2 (ensiling temperatures) arrangements of treatments was used for the study. Wetting the corn silage increased (P<0.05) concentrations of NH3-N. Ensiling the corn at 40°C instead of 30°C increased (P<0.001) the pH (4.23 vs. 3.76) and NH3-N concentration, and reduced (P<0.05) lactate, acetate and propionate concentrations. Delaying sealing for 3 h reduced NH3N (P<0.05) concentration. Yeast counts were reduced (P<0.05) by wetting the corn, ensiling at the higher temperature and delaying sealing, while mould counts tended (P<0.1) to be reduced by delaying sealing. There were no interactions (P>0.05) between the treatments for the measurements except for aerobic stability, which was greater in the corn silage that was watered, ensiled at 40°C and sealed after a 3 h delay than in the other treatments. None of the treatments affected the lactic to acetic acid ratio. This study suggests that high temperatures during ensiling adversely affect the quality of corn silage. The simulated rainfall increased proteolysis, but delaying sealing for 3 h reduced proteolysis.

Key Words: Corn Silage, Moisture and Temperature, Delayed Sealing

665 Factors affecting the quality of corn silage grown in hot, humid areas 2: Effect of applying two dual-purpose inoculants or molasses. A. Adesogan*[1], M. Huisden[1], K. Arriola[1], S. Kim[1,2], and J. Foster[1], [1]*University of Florida*, *Gainesville*, [2]*Gyeongsang National University*, *Jinju, South Korea*.

This study determined how applying molasses or two proprietary inoculants affects the fermentation and aerobic stability of corn silage. A corn hybrid grown in four replicated plots was harvested at 400 g/kg DM and ensiled (15 kg) in quadruplicate in 20 l mini-silos. Treatments applied included Control, molasses (50 g/kg DM; Mol), BB inoculant (containing *Pediococcus pentosaceus* and *Lactobacillus buchneri*) and PN inoculant (containing *L. plantarum* and *L. buchneri*). The inoculants were applied 1× or 2× (DBB and DPN) the recommended rates. After 135 d of ensiling, silage chemical composition, aerobic stability and microbial counts were determined. The following results are based on comparing treated to Control samples. There were no treatment effects on IVDMD, CP, NDF or ADF concentrations. The pH, and NH3-N and lactate concentrations of Control and treated silages were similar (P>0.05), except for PN-treated silages, which had slightly higher (P<0.05) pH (4.06 v. 3.84) and NH3-N, and less (P<0.05) lactate (15.1 v 26.0 g/kg DM) than Control silages. Acetate concentration (g/kg DM) was greater (P<0.05) in PN, DPN and DBB silages (30.8, 40.3, 34.9), and numerically greater in BB and Mol silages (23.1 and 16.8) than in Control silages (14.3 g/kg DM). Residual sugar concentration was similar (P>0.05) in Mol and Control silages, and less (P<0.05) in inoculant-treated silages than in Control silages. Aerobic stability of disturbed silage samples was greater (P<0.05) in all inoculant-treated silages than in the control silage. Aerobic stability of undisturbed silage samples were not affected by treatment, though inoculant treated silages were numerically more stable. Dual purpose inoculants can increase the aerobic stability of corn silage without adversely affecting nutritive value. Molasses treatment did not affect the quality or aerobic stability of corn silage.

Key Words: Inoculant, Corn Silage, Molasses

666 Comparison of hays harvested at three stages of grass maturity in their effects on chewing activity and ruminal pH fluctuation of cows. F. Dohme* and A. Muenger, *Agroscope Liebefeld-Posieux, Swiss Federal Research Station for Animal Production and Dairy Products (ALP)*, *Posieux, Fribourg, Switzerland*.

Hay is used in rations for dairy cows as a source of effective fiber in order to maintain optimal rumen function. Thus, the objective of the experiment, carried out according to a 3 × 3 Latin square design, was to compare the effect of an immature hay harvested after 36 d of regrowth (**A**) to two mature hays harvested either 50 (**B**) or 61 d (**C**) after regrowth on chewing activity and ruminal pH fluctuation in six nonlactating rumen-cannulated cows. Each experimental period lasted 21 d with data collection from d 14 to 21. The hays (ryegrass-clover mixture) were fed ad libitum and feed intake was recorded daily. Ruminal pH and chewing activity were continuously recorded for 22 h/d with an indwelling pH electrode and with a behavior recorder, respectively. For each cow pH data were summarized separately for the day and night as mean, maximum and minimum pH and time period when pH was below 6.2. Chewing activity was separated into eating, ruminating and idling time. The hays did not differ in the DM content whereas hay A had per kg DM 16 g less NDF and 4 g and 14 g more sugar than hay B and C. With hay A, intake of DM (15.5 kg) and sugar (1.66 kg), but not of NDF (6.65 kg), was increased ($P < 0.05$) compared to hay B and C (DM: 14.7, 14.6 kg; sugar: 1.53, 1.38 kg; NDF: 6.52, 6.49 kg). The hays did not affect daily eating and idling activity. Compared to hay B and C, cows offered hay A spent 18 min/d less ($P < 0.05$) time ruminating and when expressed per kg DM or NDF intake rumination time was 2.8 and 4.2 min shorter ($P < 0.05$ for each), respectively. Only during the day mean and maximum pH was 0.16 and 0.22 units lower, respectively and the time when pH was below 6.2 was 158 min longer in cows fed hay A compared to hay B and C ($P < 0.05$ for each). The mean rumen pH over 22 h was negatively correlated to sugar intake (r = -0.67; $P < 0.01$) and unexpectedly to NDF intake (r = -0.43; P

= 0.07). In conclusion, increasing sugar intake with immature hay reduced rumen pH. Nutrient differences between hay B and C were small and could explain the lack of difference in chewing activity and rumen pH.

Key Words: Chewing Activity, Grass Maturity, Rumen pH

667 Comparative effect of brown midrib sorghum-sudan and corn silages on lactational performance, nutrient digestibility, and phosphorus retention in Holstein dairy cows. H. M. Dann[1], C. S. Ballard[1], E. D. Thomas[1], K. W. Cotanch[1], C. T. Hill[1], R. J. Grant*[1], R. Rice[2], and W. Townsend[2], [1]*W. H. Miner Agricultural Research Institute*, *Chazy, NY*, [2]*Garrison & Townsend*, *Hereford, TX*.

Total mixed rations containing brown midrib sorghum-sudan grass silage (bmrSS) or corn silage (CS) at either 35 or 45% of dietary dry matter were fed to Holstein dairy cows to determine the effect on lactational performance, nutrient digestibility, and phosphorus retention. Twelve cows were assigned to one of four diets in replicated 4 × 4 Latin squares with 21-d periods. In vitro 30-h NDF digestion was 46.0% for CS and 58.3% for bmrSS. Dry matter intake was greatest when cows were fed the 35% CS (23.4 kg/d) and 45% CS (23.2 kg/d) diets, was least when cows were fed the 45% bmrSS diet (17.6 kg/d), and was intermediate when cows were fed 35% bmrSS diet (20.1 kg/d). The bmrSS diets resulted in greater BW gain per period, but similar body condition score versus CS diets. Yield of solids-corrected milk was similar among diets. Efficiency (SCM/DMI) was greater for cows fed the bmrSS than the CS diets. In vivo digestibility of organic matter and CP was greater for the CS diets than the bmrSS diets, but digestibility of neutral detergent fiber, starch, and nonfiber carbohydrate was similar among diets. Ruminal pH was greatest when cows were fed the 45% bmrSS diet (6.58), was least when cows were fed 35% CS (6.10) and 45% CS diets (6.13), and was intermediate when cows were fed the 35% bmrSS diet (6.42). Ratio of acetate (A) to propionate (P) was greatest for the bmrSS diets with no difference among diets in total VFA concentration. Phosphorus (P) balance was positive when cows consumed the 35% CS (14.6 g/d) and 45% CS (10.1 g/d) diets and slightly negative when cows consumed the 35% bmrSS (-0.1 g/d) and 45% bmrSS (-7.0 g/d) diets, but at 45% forage, fecal excretion of P was less for bmrSS than for CS. In conclusion, cows fed bmrSS had similar SCM yield with greater efficiency of production, greater ruminal pH and A:P than cows fed CS. With these diets, bmrSS was an effective alternative to the CS hybrid when fed at either 35 or 45% of the dietary DM.

Key Words: Brown Midrib, Sorghum-Sudan, Dairy Cattle

668 Exogenous fibrolytic enzymes accelerate in vitro degradation of ammonia-treated rice straw. J.-S. Eun*[1], K. A. Beauchemin[1], S.-H. Hong[2], and M. W. Bauer[3], [1]*Agriculture and Agri-Food Canada*, *Lethbridge, Alberta, Canada*, [2]*Sahmyook College*, *Seoul, Korea*, [3]*Syngenta Biotechnology Inc.*, *Research Triangle Park, NC*.

Supplementation with exogenous fibrolytic enzymes (EFE) can be a potential means of improving cell wall digestion and increasing nutritive value of rice straw for ruminants. Two cellulases (END1 and END2) and two xylanases (XY1 and XY2) supplied by Zymetrics (Golden Valley, MN) were evaluated for their potential to improve in vitro degradation of untreated (URS) or ammonia-treated (ARS) rice straw. Fresh, milled URS or ARS (0.45 g DM) was weighed into fermentation bottles in six replications. The resuspended enzyme products with 10 mL of water were added to rice straw at 0.4 mL/g DM substrate. Anaerobic buffer medium (18 mL) and strained ruminal fluid (4.5 mL) were sequentially added to the corresponding bottles. Headspace gas production (GP) was measured during 24 h of incubation. Apparent DM, NDF, and ADF degradation were determined at the end of the incubation. In addition, the VFA profiles were determined. Data were analyzed using the Proc Mixed procedure of SAS. While GP was not affected by adding EFE to URS, GP was increased ($P < 0.001$) starting at 18 h of incubation by adding XY1 and XY2 to ARS. Regardless of adding EFE, overall GP from ARS was two-fold higher than that from URS. Adding EFE did not affect degradability of URS. In contrast, degradabilities of DM and NDF increased ($P < 0.05$) by adding XY1 and XY2 to ARS, and ADF degradability increased ($P < 0.05$) by adding all EFE. Total VFA production was not affected by adding EFE to URS or ARS. Molar proportion of acetate decreased ($P < 0.05$) by adding XY1 and XY2 to ARS, and that of propionate increased ($P < 0.05$) by adding XY2, resulting in decreased acetate to propionate ratio ($P < 0.05$). In vitro degradability of URS was not enhanced by using EFE, whereas adding xylanases improved degradability of ARS. A synergistic relationship exists between ammonia treatment and addition of xylanase enzymes for the improved degradation of rice straw.

Key Words: Fibrolytic Enzymes, Rice Straw, In Vitro Degradation

669 Assessment of two indigestible markers for improving the accuracy of measurement of feed intake by cattle fed ryegrass. A. V. Chaves*, R. Delagarde, and A. Boudon, *UMRPL - INRA*, *St-Gilles, France.*

Estimation of feed intake by cattle is difficult, whether as a group or on an individual basis using indigestible markers and fecal sampling. Many researchers have expressed concern over the accuracy of intake estimates. The objective here was to verify whether multiple marker techniques could improve estimates of forage intake by grazing animals. The experimental design was a cross-over 4 × 4 Latin square with four 14-d periods. Four dairy cows were fed freshly cut ryegrass (*Lolium perenne*) in individual troughs (indoors) and four other cows grazed ryegrass pasture *ad libitum*. Herbage height post-cut was aimed to be identical to herbage height post-grazing. Intake by the cows fed indoors was calculated by weighing ryegrass offered and refused at every feeding, combined with herbage DM measurements and regression against estimated intake using twice daily doses of chromium and ytterbium oxides. Herbage intake was estimated over 5 consecutive days. The fecal samples were collected in the tie-stall for cow fed indoors and in the paddocks from grazing cows. Representative feed and fecal samples were analyzed for CP and ADF, and organic matter digestibility (OMD) was estimated as: [OMD = 1.035 - 2.478/CP_{feces} - 0.0027*ADF_{feces} - 0.0571*CP_{feed}/CP_{feces}], where CP and ADF are expressed as % of OM (n = 31, $r^2 = 0.92$, SE = 0.0094). Actual daily DMI (16.6 ± 2.3 kg; mean ± SD) was lower ($P \leq 0.05$) than the values (y) predicted using chromium oxide (19.4 ± 4.3 kg; $y = 8.43 + 0.39x$, $r^2 = 0.49$) or ytterbium oxide (19.0 ± 3.7 kg; $y = 7.75 + 0.47x$, $r^2 = 0.60$). When estimated intakes from both markers were averaged (y) and plotted against actual values (x), multiple marker techniques did not improve estimates of forage intake by grazing animals, where $y = 7.92 + 0.44x$, $r^2 = 0.54$, with a mean bias of +3.2 kg DM. In conclusion, the accuracy of intake measurements for cows fed ryegrass pasture was not improved using Cr and Yb oxides indigestible markers.

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Key Words: Intake, Markers, Pasture

670 Soybean hulls as an energy source for rotationally grazed Holstein heifers. J. A. Jackson*, L. J. Driedger, S. T. Franklin, M. T. Sands, K. I. Meek, J. V. Ware, and C. H Hamilton, *University of Kentucky*, *Lexington*.

Three replicated studies were conducted in spring 2003, fall 2003 and spring 2004 to evaluate the use of soybean hulls versus corn as an energy source in growing Holstein dairy heifers using intensive rotational grazing management. Hallmark® Orchardgrass (*Dactylis Glomerata L.*) was established in a 4.45 ha field during the fall of 2001. The field was divided into forty-eight 0.06 ha paddocks and one 0.5 ha section using 5 wire poly-electric fence tape. Heifers were contained as a group in the 0.5 ha section of the field to adapt to the electric fencing and pasture for 1 wk before being assigned to their respective dietary treatments. In each replicated study, 18 Holstein heifers (250 ±40 kg) were divided into pens of 3 and randomly assigned to one of two treatment groups. Dietary treatments were 1)1.8 kg/h/d of a corn based diet (control; 2.07 Mcal/kg of NE_m and 1.39 Mcal/kg of NE_g) or 2) 1.8 kg/h/d of a soybean hull based diet (SBH; 1.6 Mcal/kg of NE_m and 1.01 Mcal/kg of NE_g). Heifers were rotated to a new paddock every 3.5 d which allowed 28 d rest before paddocks

were re-grazed a second time within a replicate. Full body weights were determined initially and every 2 wk until termination at 6 wk. The pen of 3 heifers was used as the experimental unit. Forage samples were collected initially and every 2 wk until termination for quality and yield determinations. Statistical analysis revealed no effect due to season. A treatment by week interaction was detected ($P < 0.05$). Average daily gains did not differ ($P > 0.05$) and were 1.06 and 1.13 ± 0.07 kg/d for the control and SBH treatment groups, respectively. Results indicate that soybean hulls, as an energy supplement, can support equal average daily gains as corn for growing dairy heifers under intensive rotational grazing management.

Key Words: Soybean Hulls, Grazing, Dairy Heifers

671 Effect of variety on chemical composition and ruminal nutrient degradability of forage soybean silage. A. Mustafa* and P. Seguin, *McGill University*, *Ste-Anne-De-Bellevue, QC, Canada*.

A study was conducted to determine the effects of of soybean variety on chemical composition and ruminal nutrient degradabiity of silage. Two varieties of forage soybean (i.e. Kodiak and Mammouth) were sown in a field in Southwestern Quebec on May 15 2004 and harvested on September 4 2004. Harvested forages were then ensiled in mini-silos for 45 d. Two ruminally fistulated Holstein cows, in a randomized complete block design, were used to determine in situ ruminal nutrient degradabilities of the two soybean silages. Chemical analysis showed Mammouth contained higher ($P < 0.05$) NDF (49.0 vs 44.4%), ADF (37.1 vs 35.3%), and ADL (8.1 vs 6.4%) levels than Kodiak. However, CP was higher ($P < 0.05$) for Kodiak than Mammouth (20.8 vs 14.9%). Distribution of protein fractions showed that Mammouth had lower ($P < 0.05$) soluble protein and higher ($P < 0.05$) neutral and acid detergent insoluble protein levels than Kodiak. Results of the in situ study indicated that Kodiak had higher ($P < 0.05$) ruminal DM (60.6 vs 54.9%), CP (82.8 vs 75.2%) and NDF (27.2 vs 22.7%) degradabilities. It was concluded that chemical composition and ruminal nutrient degradabilities of forage soybean silage are significantly affected by variety.

Key Words: Forage Soybean, Chemical Composition, Ruminal Degradability

672 Non-protein nitrogen formation in legume silages as influenced by condensed tannins, polyphenols, and harvesting methods. J. Grabber*, C. Davidson, and L. Massingill, *USDA-ARS, US Dairy Forage Research Center*, *Madison, Wisconsin*.

The inhibition of non-protein nitrogen (NPN) formation in legume silages by protein-binding tannins and polyphenols may be influenced by the degree of tissue disruption during harvest. In 2002 and 2003, first and second cuttings of alfalfa, birdsfoot trefoil, and red clover were conventionally conditioned, wilted, and chopped or severely macerated and wilted before ensiling in minisilos. Silages were analyzed for dry matter (DM), pH, total nitrogen (N), ammonia, free amino acids, free peptides, and NPN. Silage DM averaged 34.7% and pH averaged 4.5 with no biologically relevant differences noted between forages and harvest methods. The average N content of alfalfa (3.6% of DM) was slightly greater ($P < 0.05$) than that of other forages (3.3% of DM). Harvesting method did not affect the N content of silages. Non-protein nitrogen in alfalfa silage (free of both tannins and polyphenols) averaged 69% of total N. The formation of NPN was similar or up to 22% lower ($P < 0.05$) in low to high tannin populations of birdsfoot trefoil and 37% lower ($P < 0.05$) in polyphenol-containing red clover. The formation of NPN in silage was also less ($P < 0.05$) with macerated forage (51% of total N) than with conventionally harvested forage (66% of total N). The NPN fraction of alfalfa silage was composed of 9% ammonia, 46% free amino acids, and 45% free peptides. Tannins, polyphenols, and maceration reduced levels of all NPN components, particularly the peptide fraction. The inhibition of NPN formation by maceration was greater in tannin-containing birdsfoot trefoil than in alfalfa or polyphenol-containing red clover. The results of this study indicate that tannins, polyphenols, and maceration inhibit NPN formation in legume silages, particularly if tannin-containing forages are macerated during harvest.

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Key Words: Silage, Tannins, Non-Protein Nitrogen

Growth and Development: Growth Factors and Growth

673 Small intestinal composition and hydrolytic activity in neonatal calves fed nucleotides. C. Oliver*[1], C. De Jesus Arias[2], W. Keller[1], M. Bauer[1], and C. Park[1], [1]*North Dakota State University*, *Fargo*, [2]*Instituto Superior de Agricultura*, *Santiago de los Caballeros, Dominican Republic*.

The aim of this study was to determine the impact of dietary nucleotides on the small intestine of neonatal calves. Nineteen newborn Holstein bull calves (41.9 ± 1.1 kg initial body weight [BW]) were assigned to one of two dietary treatments: standard milk replacer or milk replacer supplemented with purified nucleotides at 5 times the level found in normal cow milk(monophosphate form of adenosine = 0.04, cytidine = 1.14, guanosine = 0.48, inosine = 0.64, and uridine = 10.3 µmol/kg BW per d). Calves were housed indoors in individual pens with slatted floors. At about 4 wk of age calves were weighed and given a sodium pentobarbital overdose. Small intestine was removed; samples of duodenal, jejunal, and ileal segments were harvested, the mucosa removed and flash frozen. Remaining intestine was emptied, weighed, and the length measured. Mucosal homogenate was analyzed for DNA, RNA, protein, and activity of the intestinal enzymes lactase, maltase, alkaline phosphatase, aminopeptidase N, and dipeptidylpeptidase IV. There were no differences ($P \geq 0.51$) between treatments in final body or small intestinal weights; mucosal weight, protein or RNA content, or lactase, maltase, alkaline phosphatase, or dipeptidylpeptidase IV activity. Small intestine was numerically longer in nucleotide-fed calves ($P = 0.11$). There were site of intestine effects ($P \leq 0.01$) for RNA, protein, and all enzyme activities except dipeptidylpeptidase IV. Gut DNA was influenced by an interaction of site and treatment ($P < 0.01$): DNA content increased distally, levels were similar between treatments in the duodenum and jejunum, and higher for the nucleotide group in the ileum. Aminopeptidase N was lower ($P = 0.04$) in nucleotide-fed calves, which may indicate an increase in gut maturity. Dietary nucleotides may enhance small intestinal development. Further work is needed to determine optimal dose and timing of administration.

Key Words: Nucleotide, Small Intestine, Calf

674 Fibroblast growth factor receptor 1 regulates protein metabolism in atrophic muscle. J. K. Eash*, A. L. Grant, K. M. Hannon, and D. E. Gerrard, *Purdue University*, *West Lafayette, IN*.

Skeletal muscle disuse and subsequent loss of protein is attenuated by augmenting fibroblast growth factor (FGF) signaling. The exact mechanism for this blunted muscle wasting is not known. Therefore, the objective of this study was to determine how FGF signaling affects muscle protein metabolism during disuse atrophy. Mouse gastrocnemius and soleus muscles were injected with plasmid DNA encoding fibroblast growth factor receptor 1 (FGFR-1) or control plasmid DNA, and pulsed 8 times at 200V/cm using a pulse stimulator. Mice were randomly assigned to hindlimb suspension (10d) or control treatments. Protein synthesis was determined using a flooding dose of L-[4-^{3}H]phenylalanine. Muscle proteosome activity was evaluated using electroporation of plasmid DNA encoding for ubiquitinated luciferase. Sus-