



# **Bison Feedlot Nutrition**

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## It All Starts With Animal Acquisition

- From What Source: Sale/Auction or Private Treaty
- At What Age?: Weanlings versus Yearlings
- What Gender?: Heifers versus Bull calves
- From What Geographical Location?: Transport distance
- At What Time of Year?: Winter, Spring, Summer, Fall
- From What Management Regimen?: Deworming/Vaccination protocols; Pasture/Hay Quality; Supplemental/Creep Feeding





# Feedlot Preparation for Arrivals



- The Feedlot should be prepared as follows
  - Ensure all alleyways, gates and fencing are properly maintained
  - Clean and disinfect automatic waterers or tanks within feed pens and fill with fresh water
  - Clean and disinfect self-feeders or bunks and fill with fresh feed
    - Make certain that self-feeders are cleaned both inside and out to allow for adequate flow of feed with no mold or caking present
    - Make certain that bunks are cleaned and in a good state of repair
  - Clean and disinfect hay feeders and fill with fresh hay
    - Make sure contaminated or old hay is removed and disposed of
  - Clean pens dedicated for new arrivals – remove all manure and provide bedding as needed based on current weather conditions



# Arrival at the Feedlot



## Cattle Receiving Protocol

- Feedlot Identification-Flop/RFID
- Weight and Body Condition Score
- Vaccinations-MLV, and/or Killed, Commercial
- Deworming-Injectable, Pour-on
- Metaphylaxis-BRD

## Bison Receiving Protocol

- Feedlot Identification-Flop/RFID
- Weight and Body Condition Score
- Vaccinations-Killed, Commercial and/or Autogenous
- Deworming-Injectable, Pour-on



# Bison Body Condition Scoring

Score	Description
1 – Very Thin	Ribs prominent, Spine sharp, Hip bone prominent, Tail head devoid of fat and sunken, Hump sharp topline
2 – Moderately Thin	Ribs visible, Spine evident, Hip bone evident, Tail head sunken on both sides, Hump narrow but not sharp
3 - Moderate	Ribs may be visible but usually covered, Spine visible, Hip bone visible, Tail head with slight hollowing, Hump well developed but not bulging
4 – Moderately Fat	Ribs covered, Spine not readily seen, Hip bone barely visible, Tail head with little to no depression, Hump full with little distinction between it and shoulder
5 – Very Fat	Ribs covered, Spine buried in fat, Hip bone covered in fat, Tail head with no depression or bulging, Hump thick, rounded and indistinguishable from shoulder



# “Never Ever”

USDA Process Verified Program Never Ever 3		
1-No Antibiotics	2-No Growth Promotants	3-No Animal By-Products
<p>No antibiotics can be administered whether through feed, water, or by injection, from birth to slaughter.</p> <p>This includes low-level (sub-therapeutic) or therapeutic level doses, sulfonamides, and ionophores.</p> <p>However, ionophores used as coccidiostats for parasite control may be used. See Note 1 below.</p> <p><b><i>If animals require antibiotics for treatment of illness, they must be treated and removed from the program.</i></b></p>	<p>The administration of growth hormones, including natural hormones, synthetic hormones, estrus suppressants, beta agonists, or other synthetic growth promotants is prohibited from birth to slaughter.</p>	<p>Mammalian and avian by- products are not allowed in the feed.</p> <p>These by-products include animal waste (e.g. poultry litter) and by-products as defined by 9 CFR 301.2 (e.g. products derived from the slaughter/harvest process including meat and fat).</p> <p>Fish by-products and vitamin and mineral supplementation are permissible. See Notes 2 and 3 below.</p>
<p>Any animal that receives any of the “Never Ever 3” prohibited substances must be identified as nonconforming and removed from the program.</p>		
<p><i>Note 1:</i> Programs requesting approval to use ionophores as coccidiostats must provide a parasite treatment and control plan as part of their quality management system and must meet the FSIS labeling requirements specific to the use of ionophores as coccidiostats to prevent parasitism.</p>		
<p><i>Note 2:</i> If fish by-products are feed, it must be declared in the program’s documentation and posted on the AMS web site.</p>		
<p><i>Note 3:</i> Vitamins and minerals, including salt, are not considered feed additives for this program and are not subject to the Never Ever 3 requirements.</p>		
<p><i>Note 4:</i> US born animals verified under this program qualify as “Product of the USA”.</p>		

# Placement in the Feedlot



## Cattle

- Pen Space – 200 sq ft/hd initially adjusted to 150 sq ft/hd
- Bunk Space – 12 inches/hd initially adjusted to 6-9 inches

(Pollreisz et al., 1986)

## Bison

- Pen Space – 400 sq ft/hd minimum
- Bunk Space – 24 inches/hd minimum

Humane Farm Animal Care – Animal  
Care Standards – January 1, 2014

# So... Acquisition, Relocation, Processing... What does it spell??





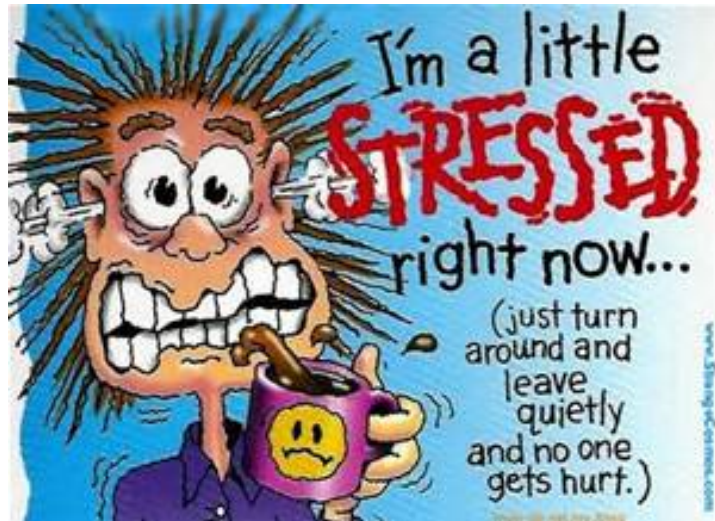
Stress Reduction Kit

**Bang  
Head  
Here**

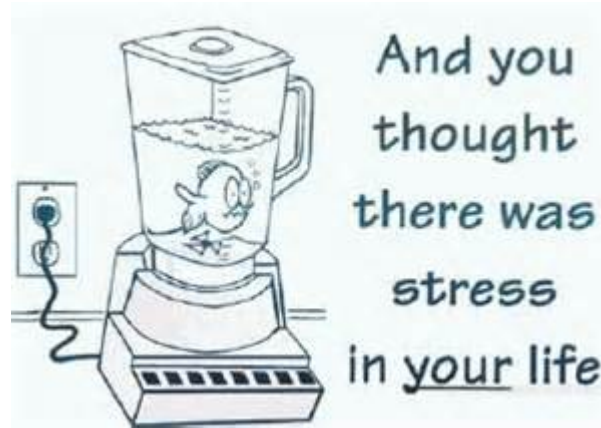
- Directions:
1. Place kit on FIRM surface.
  2. Follow directions in circle of kit.
  3. Repeat step 2 as necessary, or until unconscious.
  4. If unconscious, cease stress reduction activity.
- ANAJOKES.COM



"Relax, they're just worry warts."



# STRESS



# STRESS

- An animal is under stress when it has to make extreme functional, structural, behavioral or immunological adjustments to cope with adverse aspects of its environment. (Gwasdauskas, et al., 1975)
- Transportation stress is considered a major stressor in livestock. (Von Borrell, et al., 2005)
- Harmful handling as well as restraint during management procedures may cause the animal to injure or stress itself or a worker. (Burdick, et al., 2011)
- Long-term or chronic stress influences a number of systems including the immune, digestive and reproductive systems. It can also influence hormones essential in growth, energy metabolism and response to disease or infection. These deficiencies can continue after the stimulus from the stressor has been diminished or eliminated (Stull, 1997)

# Stressors

- At the Ranch – Weaning Stress, Handling Stress, Commingling Stress
- Transport – From the Ranch to the Sale Venue/Auction Mart - Handling Stress, Commingling Stress
- At the Sale/Auction – Handling Stress, Commingling Stress
- Transport – From the Sale Venue/Auction Mart to Feeder Operation - Handling Stress, Commingling Stress
- Feeder Operation - Pasture, Feedlot (or somewhere in between) – Handling Stress especially when implementing a receiving protocol and Commingling Stress (Sort by sex, age, weight??)

**What body systems are most impacted by all these stressors??**



# What body systems are most impacted by all these stressors?



- IMMUNE SYSTEM
- ENDOCRINE SYSTEM
- GASTROINTESTINAL TRACT

**What supports the proper functioning of these systems?**



# What supports the proper functioning of these systems?



# NUTRITION





# Nutrition – General Concepts

- Bison are considered grazing ruminants that feed roughly 4 to 9 times a day and consume large quantities of forage per feeding. (Feist, et al., 2000)
- Bison have somewhat higher populations of cellulolytic (fiber digesting) bacteria than cattle thus requiring additional energy and nitrogen which is most likely supplied by the higher available energy obtained from prolonged dry matter digestion and from an efficient system for recycling endogenous nitrogen. (Cocimans and Leny 1967, Houpt 1970, Kenedy and Milligan 1980, Egan, et al., 1986)
- Bison saliva is 30% higher in nitrogen than cattle and bison serum is 38% higher in urea than cattle but do not differ in urine levels of urea. Thus, urea conservation in the bison contributes to higher levels of urea nitrogen for rumen microbial growth.
- Bison undergo a period of metabolic down regulation during the winter months thus causing a period of weight loss upwards to 10 to 15% of body weight only to recover during a period of compensatory gain as spring approaches.

# Total Tract Retention Time – Dry Matter Digestibility of Select Forages

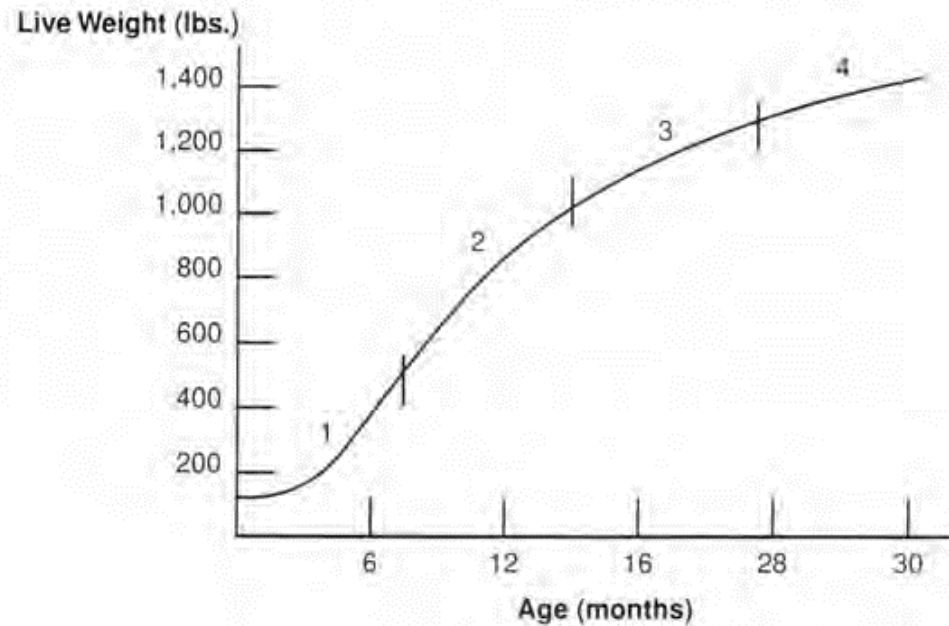
	BISON	CATTLE
Total Tract Retention Time	78.8 hours	68.7 hours
Dry Matter Digestibility		
Sedge Hay	64%	58%
Grass Hay	74%	62%
Alfalfa/Brome Hay	50%	52%
(Schaefer, Young, Chimwano, 1978)		

The longer retention time allows for fiber to be digested more completely thus theoretically making the case that bison are more efficient at processing a mature/lower quality hay source than cattle.

# Metabolic Profiles

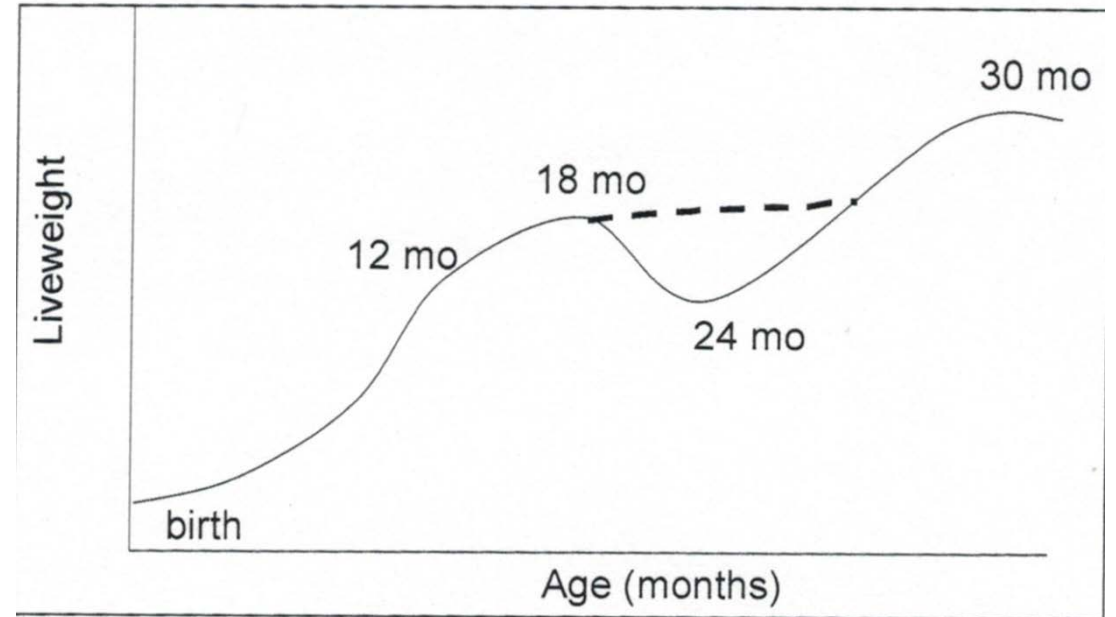
## Cattle

Live weight growth curve for Beef Cattle (Adapted from Western Canada Feedlot School Manual, 1997)



## Bison

Live weight growth curve of Bison – Note the metabolic down regulation that occurs at 18 months of age



# Comparison of Metabolic Profiles

- In cattle, the body weight is consistently increasing from birth to 30 months with rapid periods of growth (frame, muscle mass, organ development) followed by periods of slow growth (muscle mass) then followed by periods of fat deposition.
- In bison, the body weight is affected by a metabolic down regulation that ensues at 18 months of age causing a period of static/negative growth primarily during the winter, though the initial stages of growth to this point follow the pattern similar to cattle

# Winter vs Summer Parameters - Bison

	Winter	Summer
Daylight Hours	Short	Long
Metabolism	Slow (Maintenance)	Fast (Maintenance, Weight Gain, Lactation, Fat Deposition)
Dry Matter Intake	Low (1.4 to 1.8% Body Weight)	High (2.2 to 3.0% Body Weight)
Body Weight Status	Maintain or Lose Weight	Maintain or Gain Weight

(Feist, et al., 2000)



# Bison Feedlot Nutrition Goals

- Feed based on target weights of 850-900 lbs for feedlot heifers and 1050 to 1100 lbs for feedlot bulls
- Feed to support overall health and well being by maintaining bison on a good plane of nutrition.
- Feed to achieve target weights ahead of the metabolic down regulation period to minimize days on feed and maximize profit potential which correlates directly to genetic potential.





# Heifers vs. Bulls



- Heifers can be finished no different than bulls. However, heifers will achieve target weights faster than bulls based on body weight, size, average daily gain and fat deposition. Heifers have a tendency to lay down fat earlier in the finishing period than bulls.
- Bulls are more commonly selected as feeders. Though time to finish may be longer than heifers, bulls typically achieve higher average daily gains and lower fat deposition.
- Genetic potential can influence the days on feed based on a good plane of nutrition with some feedlot operators reporting 10 to 14 months to achieve target weights versus upwards to 20 months.

# So... What's For Supper??



more awesome pictures at [THEMETAPICTURE.COM](http://THEMETAPICTURE.COM)

**What is the single most  
important nutrient??**

# What is the single most important nutrient??



WATER





# Water

- Essential for feed digestion and is the first limiting nutrient – without water, dry matter intake will be restricted
- Clean, Fresh, Unlimited Access is imperative particularly during periods of high metabolic demand.
- Location of waterers is important so that animals are not competing for access. Therefore, if water and feed sources are located too close together, there is an increased risk of animal injury and ultimately poor performance
- Water Quality should be assessed to monitor pH, alkalinity, hardness, dissolved solids, sulfates, nitrates, iron, calcium, magnesium and sodium
- Bison on average will drink 5 to 10 gallons of water daily with a peak consumption reaching 15 gallons (if not more given certain environmental conditions)



# Energy



- Essential for body maintenance, growth/production and is the second limiting nutrient.
- Total Digestible Nutrients (TDN) is the sum of the digestible fiber, protein, lipid and carbohydrate components of a feedstuff. It is directly related to digestible energy and is expressed as a percentage.
- As an example, Whole Oat grain has a TDN of 76% based on dry matter intake (DMI) or is 76% digestible whereas Grass Hay may have a TDN of 50% (DMI) or is 50% digestible
- Depending on the estimated energy needs of different classes of bison, the TDN in certain feedstuffs may require supplementation.



# Crude Protein, Vitamins and Minerals

- Crude protein is the third limiting nutrient consisting of amino acids and nitrogen.
- Protein is essential for the development of muscles, nerves and other tissues and is involved in the function of normal digestion.
- Protein is also a constituent of blood, hormones, and enzyme systems that support all organ systems especially the immune system.
- Essential vitamins include A, D, E (fat soluble) as well as B complex, B12 and C (water soluble).
- Essential minerals include the macros Calcium, Phosphorus, Magnesium, Sodium, Chloride, Potassium and Sulfur as well as the micros Cobalt, Copper, Iodine, Iron, Manganese, Molybdenum, Selenium and Zinc.

# Estimated Energy, Crude Protein, Calcium and Phosphorus Requirements of Bison

Age	DMI (% BW)	TDN (%)	Crude Protein (%)	Calcium (%)	Phosphorus (%)
FEMALES					
6mo to 1 year	2.0 – 3.0	55 - 63	12 - 14	0.70	0.65
1 years	2.0 – 2.5	55 - 63	10 - 12	0.70	0.65
1.5 years	1.8 – 2.2	50 - 55	10 - 12	0.50	0.45
2 years	1.6 – 2.2	53 - 60	10 - 12	0.45	0.40
MALES					
6mo to 1 year	2.0 – 3.0	55 - 63	12 - 14	0.70	0.65
1 year	2.0 – 2.5	55 - 63	10 - 12	0.70	0.65
1.5 years	1.8 – 2.2	50 - 55	10 - 12	0.50	0.45
2 years	1.6 – 2.2	55 - 60	10 - 12	0.45	0.40
(Feist, et al. 2000)					



# Concentrates



- Concentrates are high-energy feeds that improve the rate of gain and decrease the cost of finishing thus decreasing the days on feed.
- Industry standards suggest that a grain ration be provided within at least the last 90 days prior to harvest for the purpose of ensuring the color of fat changes from yellow to white – consumer driven?
- Rule of Thumb: As fiber increases, energy decreases.
- Grains used to formulate bison feeds include wheat, corn, oats and barley. Co-products are also used such as distillers grain, wet brewers grain, wheat midds and potato waste.
- The formulation of such rations for bison must take into consideration several factors that have recently come to light by the most recent study performed at USASK by M. Woodbury and G. Penner.

**So... What does any of this mean?**



# Care and Feeding of Bison

- Survey performed in by the NDSU Carrington Research Extension Center to discover what bison feedlot producers were thinking.. (Anderson, Sexhus 1997)
- 26 Respondents represented 21% of those surveyed – of those, 23 out of 26 were owner/operators of the feedlot operation
- In addition, 12 out of the 26 responding offered performance data

# Care and Feeding of Bison

- The list of concerns were ranked as follows:
  - Genetics
  - Health
  - Marketing
  - Facilities



# Care and Feeding of Bison - Management

	Average	Standard	Range
No of head fed	42	10	2 to 200
No of head raised on site	16	4	0 to 100
No of head purchased	26	9	0 to 187
No of pens	2.33	5	1 to 13
No of head/pen	18	5	2 to 200
Pen space per head (sq ft)	2,350	518	280 to 9,000
No of times worked/year	2.64	0.3	0 to 6

# Care and Feeding of Bison – Feedlot Enterprise

	Percent of Those Surveyed
Own a scale	32
Have weather protection – shelterbelt	95
Have weather protection – wind fence	23
Have lights in the feedlot	49
Use self-feeders	88
Use bunk feeders	25
Consider lots well drained	50
Consider lots acceptable	42
Consider lots poorly drained – too muddy	8
Use bedding	68
Spray premises with insecticides	23
Spray bison with insecticides	16

# Care and Feeding of Bison - Concentrates

	No of Those Surveyed	Avg Use - %	Range of Use - %
Wheat Midds	14	77	25 to 100
Corn Grain	8	5	10 to 75
Barley	7	61	25 to 100
Oats	5	43	25 to 67



# Care and Feeding of Bison - ADG

	No of Those Surveyed	Average Daily Gain (lb/day)
Wheat Midds based diet	6	1.54
Barley based diet	3	1.59
Custom diet	3	1.84



# Care and Feeding of Bison - Concerns

	Frequency Mentioned (%)
Rate of Gain	39
Feed Cost	35
Feed Efficiency	26
Feed Source/Quality	22
Balanced Rations	9
Identifying Good Genetics	22
Carcass Grading	17
Pen Drainage	13
Lot Size	9
Handling Facilities	9
Deworming	26
Fly Control	13
Animal Welfare	9

# Protein Requirements of Bison Bulls Fed for Meat

- Research project performed at the NDSU Carrington Research Extension Center – Anderson, Burr, Schroeder
  - Protein is a major issue in bison diets – usually the most expensive nutrient after vitamin/mineral supplements
  - Supplemental feeding has been used to offer nutritional support during periods of inclement weather, supporting efforts to maximize conception rates in cows, to offset known mineral deficiencies and to reduce grazing pressures based on environmental conditions
  - Producers are concerned about the metabolic and economic impact to providing too little or too much protein

# Protein Requirements of Bison Bulls Fed for Meat

- Nitrogen Recycling
  - Negative nitrogen balance occurs at a lower dietary protein level with bison as compared to cattle suggesting that bison have lower protein requirements (Peden, 1972; Peden, et al., 1976)
  - Evidence suggests that blood urea nitrogen levels increase with an increase in protein levels (6% vs 15% crude protein, Keith, 1977) with excess levels recycled and eventually excreted.
  - However, further evidence suggests that nitrogen recycling occurs at even lower levels (4%, 5% and 6% crude protein, DeLiberto, 1985) as elevated ruminal nitrogen levels were discovered in the 4% and 5% diets versus the 6% diet.

# Protein Requirements of Bison Bulls Fed for Meat

- Bison cows require adequate protein levels to support body weight and reproductive function which can be dependent on age, environment, adaptation to changes, forage type and availability to name a few factors.
- Bison bulls fed for meat production typically receive supplemental feed to achieve target weight for harvest. Thus, the research study is designed to compare animal performance and cost of gain for four different protein levels.

WHAT DID THE BUFFALO SAY TO HIS SON WHEN HE LEFT FOR COLLEGE?



# Protein Requirements of Bison Bulls Fed for Meat

- Experimental Design
  - 80 Bison Bulls averaging 633 lbs were randomly assigned to 8 treatment groups
  - Supplemental feed was provided as a 75% of the diet based on 4 different protein levels – 9.4%, 11.6%, 13.9%, 16%
  - The concentrate comprised 60% corn grain to include varying levels of canola meal as the protein supplement
  - Corn silage was provided along with prairie hay
  - A standard bison vitamin/mineral supplement was also provided
  - Rations were fed once daily as a total mixed ration (TMR) in fenceline bunks

# Protein Requirements of Bison Bulls Fed for Meat

- Experimental Design
  - Bison were weighed at the start of the experiment and roughly at 90-day intervals
  - Carcass characteristics were evaluated at harvest
  - Manure samples were collected and evaluated for fecal nitrogen excretion
  - Data capture included
    - Dry Matter Intake
    - Average Daily Gain
    - Feed Efficiency
    - Gain/Feed
    - Carcass Quality and Value



# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis

Dry Matter Intake

	9.4%	11.6%	13.9%	16.0%	STD ERR
Initial Wt (lbs)	633	637	631	631	5.37
DM Intake (lb/hd/day)					
Jan to Apr	13.45	13.60	13.55	13.87	13
Apr to Sep	20.04	19.61	19.83	19.74	0.40
Overall	17.30	17.11	17.22	17.31	0.28

# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis  
Average Daily Gain

	9.4%	11.6%	13.9%	16.0%	STD ERR
Initial Wt (lbs)	633	637	631	631	5.37
Average Daily Gain (lb/hd/day)					
Jan to Apr	1.61a	1.64a	1.91b	1.83ab	0.09
Apr to Sep	1.71	1.65	1.78	1.67	0.09
Overall	1.66a	1.65a	1.84b	1.75ab	0.06

Values for a and b are statistically different (P<0.05)

# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis

Gain per Unit Fed of Dry Matter

	9.4%	11.6%	13.9%	16.0%	STD ERR
Initial Wt (lbs)	633	637	631	631	5.37
Gain per unit fed DM					
Jan to Apr	0.120	0.121	0.141	0.132	0.014
Apr to Sep	0.085	0.084	0.090	0.085	0.013
Overall	0.096	0.096	0.107	0.100	0.012

# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis

Carcass Evaluation

	9.4%	11.6%	13.9%	16.0%	STD ERR
No Carcasses	17	15	17	16	
Live Weight (lb)	1026	1005	1016	992	52.23
Hot Carcass Wt (lb)	575	566	576	576	31.66
Dressing Percentage	56.04	56.37	56.70	58.18	1.51
Quality Grade	1.06	1.07	1.24	1.15	0.32
Carcass Value (\$)	1225.35	1206.44	1212.51	1223.67	63.32

Carcass value is based on No 1 carcass price of \$2.14/lb with No 2 returning \$2.00/lb. Quality grade is based on several factors including carcass weight, fat thickness, fat color, lean color and maturity factors (measured but not included in this chart)

# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis  
Fecal Nitrogen Levels

	9.4%	11.6%	13.9%	16.0%	STD ERR
Kjeldahl Nitrogen, %DM	1.81	2.01	1.82	2.28	0.26



# Protein Requirements of Bison Bulls Fed for Meat

Dietary Crude Protein, Dry Matter (DM) basis  
Feed Cost per Pound of Gain

	9.4%	11.6%	13.9%	16.0%
Jan to Apr \$	0.36	0.38	0.36	0.41
Apr to Sep \$	0.46	0.47	0.52	0.59
Overall \$	0.42	0.44	0.45	0.51

# Protein Requirements of Bison Bulls Fed for Meat

- Discussion

- Higher protein levels appear to support improved gain to a point with 13.9% crude protein resulting in the fastest gains but with a slight increase in cost per unit of gain.
- Carcass traits were unaffected except for some improvement in dressing percentage with higher protein levels.
- Carcass value was higher for the two higher protein diets.
- Fecal nitrogen levels indicate that 13.9% crude protein does not increase excreted nitrogen thus suggesting protein accretion and lean growth.



# So... What does any of this mean?

The need for more controlled studies in the form of feed trials to understand the value of feeding forage versus concentrate rations to bison in a feedlot setting.

The need for more controlled studies in the form of feed trials to understand the value of feeding bison in different types of “confinement” settings – feedlot vs. loose confinement vs. supplemented pasture

The need for establishing the proverbial “NRC Standards” for bison as it relates to all nutrients

The need to interact among producers, agricultural agents, veterinarians, nutritionists etc to share information as to what may work and what may not based on anecdotal experiences – evidenced based... NO but in the real world, what truly is??

At the end of the day, the TAKE HOME MESSAGE is comply with basic animal husbandry standards, pay attention to the animal and use COMMON SENSE to determine what is needed to succeed.



**Questions??**



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Legendary  
Peptoboonsmal*