

Cattle nutrition

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Nature of ruminant stomach

- Four compartments
 - The rumen
 - The reticulum
 - The omasum
 - The abomasum

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The rumen

- Function of the Rumen
 - Fermentation vat filled with microbial populations which
 - Collaborate to digest cellulose and other polysaccharides
 - Produce carbon dioxide, methane and organic acids
 - Ingested food first enters the rumen
 - pH 6.5
 - Temperature of 30°C
 - Microbial digestion for 9 hours

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The rumen

- Function of the Rumen
 - The gaseous products of the microbial degradation
 - Expelled from the animal
 - Eructation
 - Cud from the rumen is regurgitated

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The rumen

- Function of the Rumen
 - Regurgitated mixture of microorganisms and partially digested materials travels through
 - Abomasum
 - Omasum
 - pH 2
 - Microbes
 - Produce
 - Protein from simple nitrogenous compounds
 - B-complex vitamins
 - Die
 - Are digested and absorbed for nutrients in the small intestine
 - Useful for the digestion of forages
 - Inefficient in the use of starches and proteins digestion

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The rumen

- Function of the Rumen
 - The volatile fatty acids
 - Produced by fermentation in the rumen
 - Absorbed across the rumen epithelium

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The reticulum

- Function of the reticulum
 - Interacts with rumen to mix and stir feed
 - Additional area for fermentation

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The omasum

- Particle size of digesta is reduced
- Excess water is removed before the digesta enters the abomasum
- Can contain up to 16 litres of digesta
- My function to absorb
 - Residual volatile fatty acids
 - Bicarbonate

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The abomasum

- The presence of food stimulates hydrochloric acid production
- Hydrochloric acid converts pepsinogen to pepsin
 - Breaks down protein to shorter molecular chain compounds
 - Peptides
 - Amino acids
- pH 2 – 4

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The abomasum

- Need to process large masses of bacteria
- Secretes lysosome
 - Enzyme that efficiently breaks down bacterial cell walls

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Small intestines

- Composed of small particles suspended in liquid digesta
- Digestion and absorption peptides and amino acids

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Nutritional requirements of dairy cattle

- Lactation
 - Dairy cows have very high nutritional requirements
 - Requirements for energy and protein
 - Diets must have sufficient nutrient concentrations
 - Support production and metabolic health

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Nutritional requirements of dairy cattle

- Feed intake
 - Dairy nutrition is managing feed intake relative to nutrient requirements
 - Feed intake (dry-matter intake) and feed efficiency (milk production per unit of dry-matter intake)

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Nutritional requirements of dairy cattle

- Feed intake
 - Dry-matter intake is influenced by
 - Feed compositional factors
 - Cow physiologic factors
 - Management factors

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Nutritional requirements of dairy cattle

- Feed intake
 - Dry-matter intake is influenced by
 - Feed compositional factors
 - Neutral detergent fiber
 - » Quality of ensiled feeds
 - Moisture
 - Fermentation products
 - » Maturity
 - Lignification
 - » Palatability
 - » Nutrient availability

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Nutritional requirements of dairy cattle

- Feed intake
 - Lactating cows managed to maximize intake rapidly after calving
 - Minimize the severity and duration of negative energy balance
 - Postpartum negative energy balance => Negatively impact body condition => Risk for postpartum disease and reproductive inefficiency

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Nutritional requirements of dairy cattle

- Carbohydrates
 - Wide range of compounds from simple sugars to complex polysaccharides
 - They account for 60%–80% of dietary dry matter for dairy cows
 - Are segregated based on chemical measures and nutritional impacts
 - Structural carbohydrates
 - Limit intake
 - Stimulate chewing and rumination
 - Helps maintain rumen buffering
 - Increase milk butterfat composition

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Nutritional requirements of dairy cattle

- Carbohydrates
 - Fiber in the diet supports rumen health
 - Fiber from forage sources that have not been finely chopped stimulates
 - Motility
 - Cud chewing
 - Salivary flow
 - These actions stimulating endogenous production
 - Salivary buffers
 - High rate of fluid movement through the rumen

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Nutritional requirements of dairy cattle

- Carbohydrates
 - Nonfiber carbohydrate
 - Organic acids
 - Sugars
 - Starch
 - Neutral detergent soluble fiber
 - Secondary plant cell wall
 - Highly fermentable and provide good sources of energy
 - Pectins
 - Beta-glucans
 - Galactans

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Nutritional requirements of dairy cattle

- Energy
 - Available for metabolic use
 - Metabolizable energy
 - Body maintenance
 - Growth
 - Lactation

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Nutritional requirements of dairy cattle

- Fats
 - Diets are low in total fat content
 - Microbial fiber fermentation
 - Polyunsaturated fatty acids

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Calcium and phosphorus requirements of dairy cattle

- Most often considered due to their roles in
 - Skeletal structure
 - Metabolism
 - Milk

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Calcium and phosphorus requirements of dairy cattle

- Calcium requirements of lactating dairy cows
 - High relative to
 - Other species
 - Nonlactating cows
- Phosphorus requirements
 - Approximately half of calcium requirements

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Calcium and phosphorus requirements of dairy cattle

- Legume and grass forages
 - Similar phosphorus content
 - Divergent calcium content
 - Legumes much higher calcium levels

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Calcium and phosphorus requirements of dairy cattle

- Parturient hypocalcemia
 - Milk fever
 - Prevention
 - Restricting dietary calcium at or below the available requirement 2–3 weeks prior to calving induces => Homeostatic system => Up-regulate calcium influx to counter subsequent colostrum and milk

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Diseases related to dietary characteristics or nutritional deficiencies

- Diarrhea
 - Numerous factors
 - Abrupt changes in diet
 - Increases in dietary nonfiber carbohydrates and dietary rumen fermentability

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Diseases related to dietary characteristics or nutritional deficiencies

- Displaced abomasum
 - Metabolic and nutritional causes
 - Feeding
 - Should be to prevent ketosis
 - Stimulate high dry-matter intakes
 - Pre- and postpartum diets
 - Important in management
 - Predisposing
 - Hypocalcemia
 - Subclinical ketosis

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Diseases related to dietary characteristics or nutritional deficiencies

- Fatty liver
 - Excess body condition
 - Late lactation
 - Dry period
 - Poor feed intake in
 - Late gestation
 - Early lactation

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Diseases related to dietary characteristics or nutritional deficiencies

- Rumen acidosis - Acute clinical
 - Major errors in feed delivery
 - Inconsistencies in feed delivery
 - High starch intake => Unaccustomed to diets => Formation of lactic acid in the rumen => Drops in rumen pH

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Diseases related to dietary characteristics or nutritional deficiencies

- Rumen acidosis - Chronic subclinical
 - Lactation diets with
 - High nonfiber carbohydrate concentrations
 - Low fiber concentrations
 - High rumen concentrations of volatile fatty acids => Rumen pH ≤ 5.6

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Water

- Availability of high-quality water
- Ad libitum consumption
- Insufficient water reduced
 - Feed intake
 - Milk production

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Water

- Water requirements of dairy cows are related to
 - Milk production
 - Dry matter intake
 - Ration dry-matter concentration
 - Salt intake
 - Sodium intake
 - Ambient temperature

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Water

- Water can be evaluated by
 - Organoleptic properties
 - Color
 - Taste
 - Smell

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Water

- Factors affecting water quality
 - pH:
 - From 5 to 9
 - Acceptable to cattle
 - Extremes
 - Concern for palatability

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Water

- Factors affecting water quality
 - Mineral content
 - Range of mineral elements
 - Essential nutrients as well as toxic elements

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Water

- Factors affecting water quality
 - Inorganic contaminants
 - Nitrates
 - Nitrite
 - Sulfates

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Water

- Factors affecting water quality
 - Organic contaminants
 - Wide range of organic compounds
 - Herbicides
 - Insecticides
 - Pharmacological agents

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Water

- Factors affecting water quality
 - Microbiological contamination
 - May cause digestive issues
 - If bacteria are present
 - Reasonable to clean watering units more frequently

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Feeding and nutritional management of dairy cattle

- Three general types are typically used in dairy production
 - Confinement systems with total mixed rations
 - Confinement systems in which concentrates and forages are fed separately
 - Component feeding
 - Pasture-based systems

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Feeding young dairy calves

- Assure adequate passive transfer of antibodies
- Calves should receive
 - At least 3 L of high-quality colostrum
 - Within 6 hours after birth
- Second feeding
 - 8 and 12 hours after birth
- Colostrum feeding
 - Until calves are 3 days old
 - Critical for passive transfer of immunity

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Traditional system dairy calf feeding

- After colostrum feeding
- Minimize financial input
- Growing the calf to weaning
- Limited quantity of liquid feed => Stimulate solid feed consumption => Stimulates early rumen development => Allowing the calf to be weaned
- Weaning
 - Relatively young age
 - 4–8 weeks
 - Growth rates are less than maximal => Feed costs are minimal
 - Risk of enteric disease

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Traditional system dairy calf feeding

- Liquid feeds for preweaned calves
 - Milk
 - Waste milk
 - Excess colostrum
 - Milk replacers

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Traditional system dairy calf feeding

- Solid feed
 - Introduced early
 - By 3 days of age
 - Starter feed
 - Stimulates rumen development
 - Volatile fatty acids
 - » Generated by microbial fermentation
 - Butyrate
 - » Rumen papillae development

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Traditional system dairy calf feeding

- Newborn calves
 - Reticulorumen
 - Underdeveloped
 - Nonfunctional
 - Rapid rumen development
 - Critical for successful early weaning
 - Minimal adverse impacts on calf
 - Health
 - Growth

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Traditional system dairy calf feeding

- Amount and form of starch
 - Induction of ruminal acidosis
 - Crude protein concentration
 - 18%–20% on a dry matter basis
 - More than 20% in accelerated feeding

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Traditional system dairy calf feeding

- Fresh water
 - Consumption >4 L/day
 - Water in milk or milk replacer is not sufficient to meet the calf's water requirement

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Feeding calves with enteric disease

- Diarrhea
 - Life threatening dehydration
 - Infectious agents
 - Bacteria
 - Viruses
 - Parasites
 - Nutritional factors
 - Electrolyte solutions administered
 - Orally
 - Parenterally

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Feeding calves from weaning through maturation

- Insufficient growth rates => Older age at first calving => Increases the cost of heifer rearing => Limits milk production and conception rates during the first lactation
- Excessive growth rates => Associated with fattening => Can affect milk production => Increase the risk of metabolic problems at calving
- Target growth rates => Based on mature weight and age at first calving
 - Daily gain
 - Smaller breeds
 - 500 g/d
 - Larger breeds
 - 800 g/d

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Feeding calves from weaning through maturation

- Environment can impact
 - Performance
 - Outcomes
- Different ages
 - Different dietary requirements
 - Kept in separate pens based on
 - Age
 - Size
 - Calves between weaning and 5 months
 - Groups of 6 or fewer
 - Older calves
 - Kept in larger groups
 - Sufficient bunk space and lying area => Ensure comfort and minimize stress

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Literature

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