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Feed Formulation for Dairy Animals

- **Importance:** Proper feed formulation is crucial for the **health, milk production, and overall performance** of dairy animals

- **Factors influencing formulation:**
  - Nutritional requirements
  - Production goals (milk yield, fat/protein content)
  - Cost considerations
  - Ingredient availability

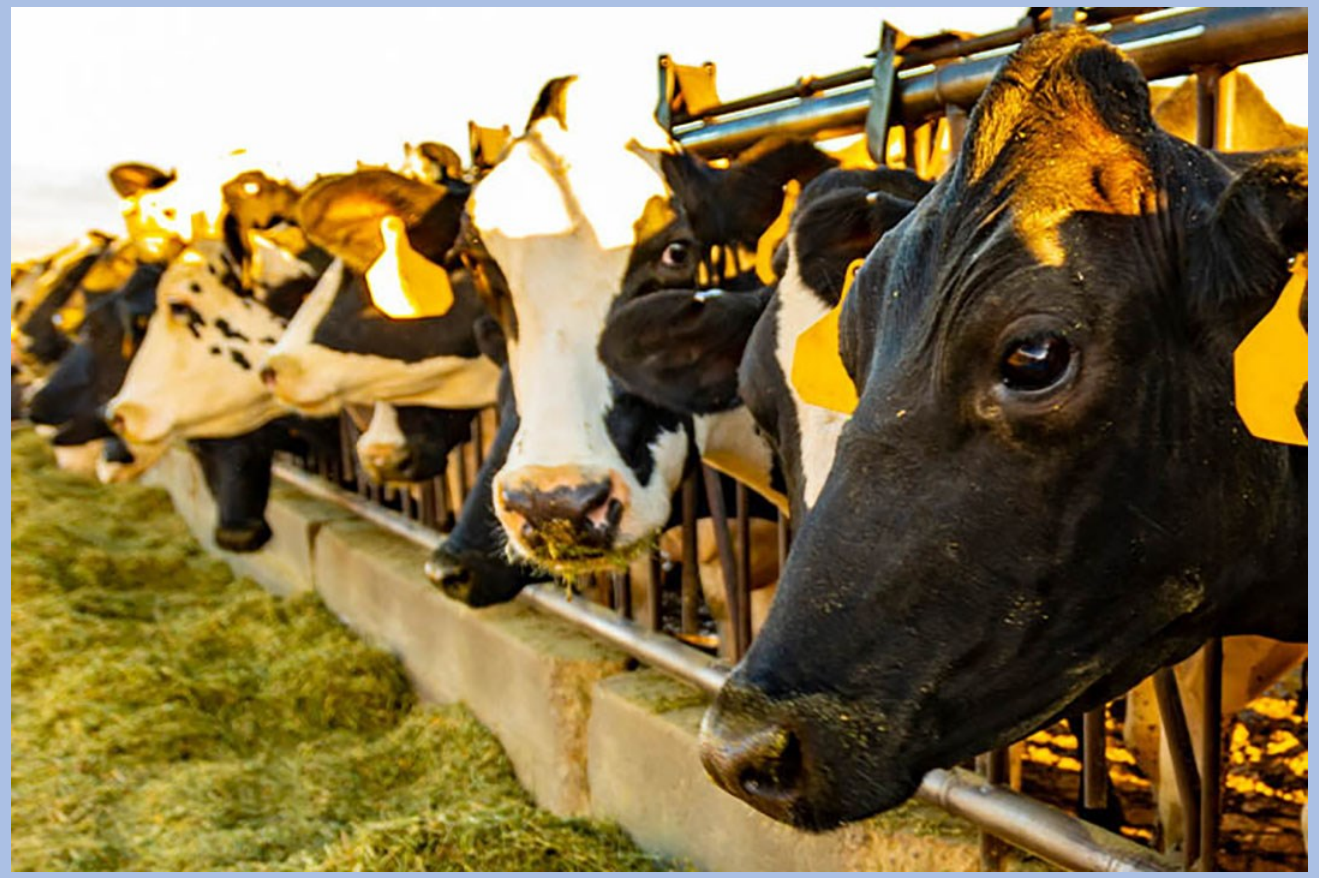
Nutritional Needs

- **Key nutrients required:**
  - Carbohydrates (energy)
  - Proteins (growth, reproduction)
  - Fats (energy, milk fat)
  - Vitamins (various functions)
  - Minerals (bone development, milk production)
  - Water (essential for all body functions)
- **Balanced diet:**
  - Prevents deficiencies
  - Optimizes animal performance

Selecting Feed Ingredients

Common ingredients:

- Forages (alfalfa, grasses, silage)
- Grains (corn, barley, oats)
- Protein sources (soybean meal, canola meal)
- Mineral supplements



Considerations for selection:

- Availability
- Cost
- Nutrient composition
- Palatability
- Impact on milk composition and animal health

Formulating diets: Meet needs at different stages of lactation and production

Achieving Nutrient Balance

Importance: Balanced nutrients (energy, protein, fiber, vitamins, minerals) support optimal health and production.

Strategies:

- Adjusting ingredient proportions
- Supplementing with specific nutrients if needed

Role of feed additives and supplements:

- Address nutrient imbalances
- Enhance animal performance
- Minimize feed costs

Meeting Production Objectives

Production goals:

- Milk yield
- Milk composition (fat, protein)
- Reproductive performance
- Profitability

Tailoring feed formulation:

- Meet specific production objectives
- Optimize animal performance
- Consider lactation stage, body condition, and environment

Ensuring Feed Quality

Importance: Nutritional adequacy and safety of feed for dairy animals.

Quality control techniques:

- Ingredient analysis
- Nutrient testing
- Feed sampling
- Assessing storage and handling practices

Quality assurance protocols: Minimize risk of contamination, spoilage, and nutrient degradation.

Implementing Feeding Strategies

Importance: Proper feeding management maximizes feed efficiency and animal performance.

Strategies:

- Ration formulation
- Feeding frequency and timing
- Delivery methods

Role of feed management:

- Reduces feed wastage
- Promotes rumen health
- Optimizes nutrient utilization for milk production

Requirements and Formulation in Dairy Nutrition

overview: This presentation focuses on understanding the **nutritional needs** of dairy animals and **formulating balanced diets** to meet those needs.

Importance: Proper nutrition is vital for **optimal health, production, and profitability** in dairy farming.

Formulating Balanced Rations

Process:

Data collection: Animal requirements, feed ingredients, production goals

Balancing rations:

- Using mathematical models or software
- Based on nutrient requirements and ingredient composition

Adjusting proportions:

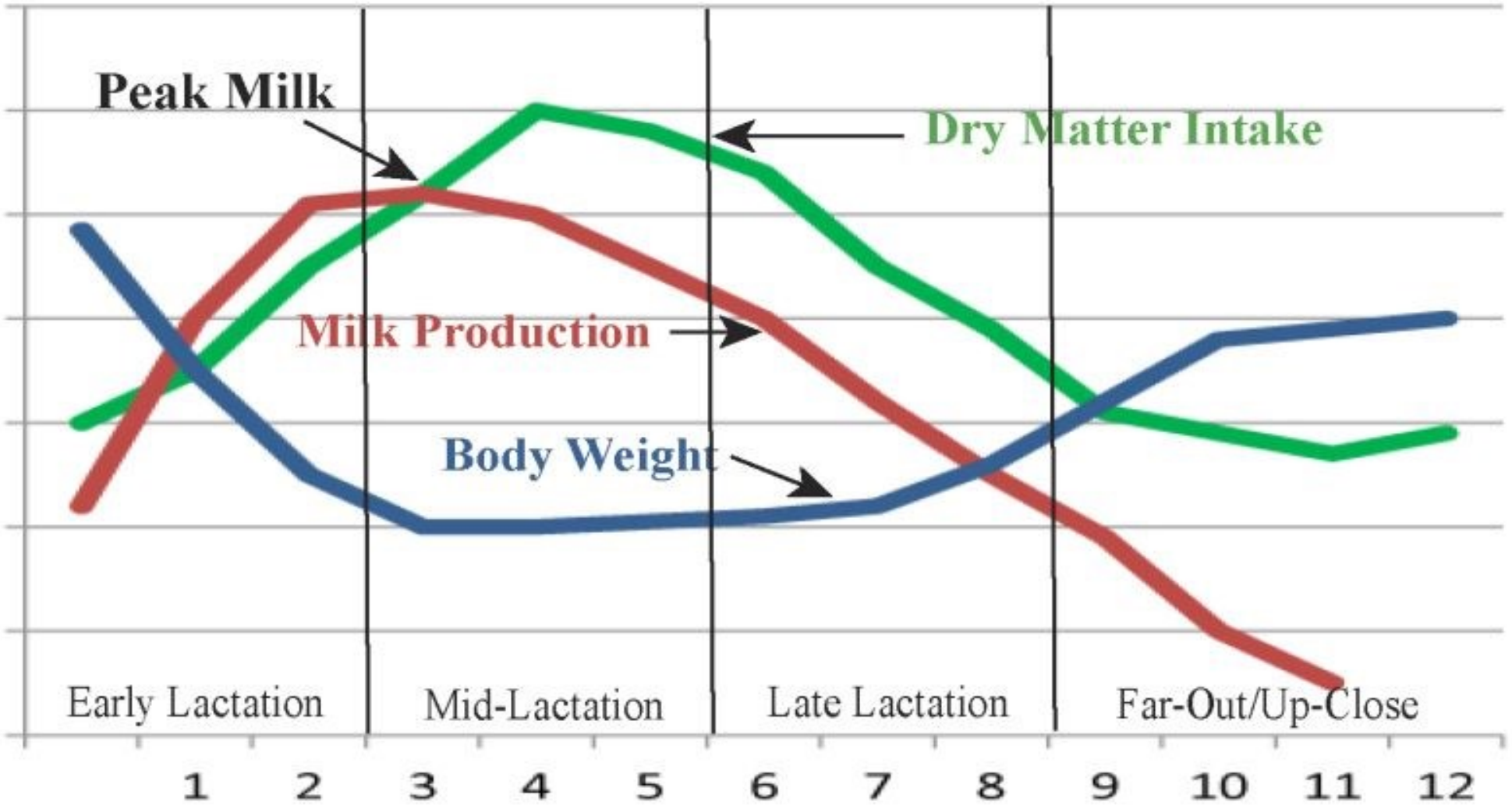
- Achieve desired nutrient levels
- Optimize feed efficiency and cost-effectiveness

Regular review and adjustments: Based on performance, feed availability, and market conditions.

Understanding Dietary Needs

- **Key Nutrients:**
  - Carbohydrates
  - Proteins
  - Fats
  - Vitamins
  - Minerals
  - Water
- **Nutrient functions:** Explained in supporting growth, maintenance, reproduction, and milk production.
- **Considerations:**
  - Different requirements for different stages (lactation, dry period, etc.)
  - Individual animal characteristics

Lactation Curve



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DRY MATTR INTAKE

Dry matter intake (DMI) guidelines for first-lactation heifers and cows of second or greater lactation are in First lactation heifers have a slow, steady rise in DMI during early lactation, reaching a plateau at about 16 weeks and remaining there for the duration of the lactation. In contrast, cows starting their second or later lactations increase DMI rapidly the first few weeks of lactation, peaking at five to six weeks of lactation and then slowly decreasing as lactation progresses.

Dry cows

For dry cows more than 21 days before calving, DMI will be about 2% of bodyweight. For cows less than 21 days before calving, a DMI of 22-24 lb. per day is a good amount to use in formulation of diets.

1. DMI (lb./day) of first lactation and greater lactation cows

	-------Milk production (lb./day) – 3.75% fat-------				
	30	50	70	90	110
Days in milk	--DMI for first-lactation cows – 1,200 lb. bodyweight--				
14	23	28	33	37	—
50	30	37	43	49	—
100	34	41	48	54	—
200	35	42	49	56	—
300	35	42	49	56	—
Days in milk –DMI for second and greater lactation cows – 1,500 lb. bodyweight–					
14	26	31	36	40	45
50	34	40	47	53	59
100	38	45	52	59	66
200	39	46	53	60	68
300	39	46	54	61	68

Meeting Energy Demands

- **Overview:** Energy requirements for maintenance, growth, activity, and milk production.
- **Dietary energy sources:** Carbohydrates (starches, sugars, fibers) and fats.
- **Strategies:** Formulating diets for sufficient energy, maintaining rumen health, and preventing metabolic disorders.

ENERGY GUIDELINES

The energy system used for lactating and dry dairy cows is net energy of lactation (NEL) and is expressed in megacalories (Mcal). Dairy cows require energy for the following functions: maintenance, lactation, activity, pregnancy and growth (Dairy NRC, 2001).

2. Energy formulation guidelines

	-Lactating cows – Stage of lactation-			--Dry cows--	
NE_L - 3X	Early	Mid	>200 days	Far-Off	Close-up
NE_L, Mcal/lb. DMI	0.78–0.80	0.74-0.78	0.72–0.75	0.62-0.66	0.65–0.68

Fiber Requirements

3. Fiber and NFC guidelines for lactating and dry cow diets[1]

	----------% of diet DM----------					
Lactating cows	**Total NDF**	**Forage NDF**	**ADF**	**NFC[2]**	**Starch**	**Sugar**
Early	> 28	> 19	> 18	37-44	24-26	5-6
Mid	29-32	20-22	> 19	35-42	23-25	5
Late	> 32	21-24	> 19	35-42	22-25	5
Dry cows	> 25	> 35	>25	< 35	< 20	5

[1]Assumes forage particle size is adequate and ground dry corn is starch source.

[2]NFC = 100 – (NDF + CP + Fat + Ash).

MP Requirement

4. MP requirements for lactating and dry cows

Parameter	MP requirement, g/day
Maintenance bodyweight, lb.	
1,000	404
1,100	410
1,200	418
1,325	423
1,425	427
Gestation - when > 220 days pregnant	**240 g + 2 g/day for every day >220**
Lactation, true milk protein %	**g/lb. of milk produced**
2.8	19
3.0	20
3.2	22
3.4	23
3.6	24

Balancing Protein Intake

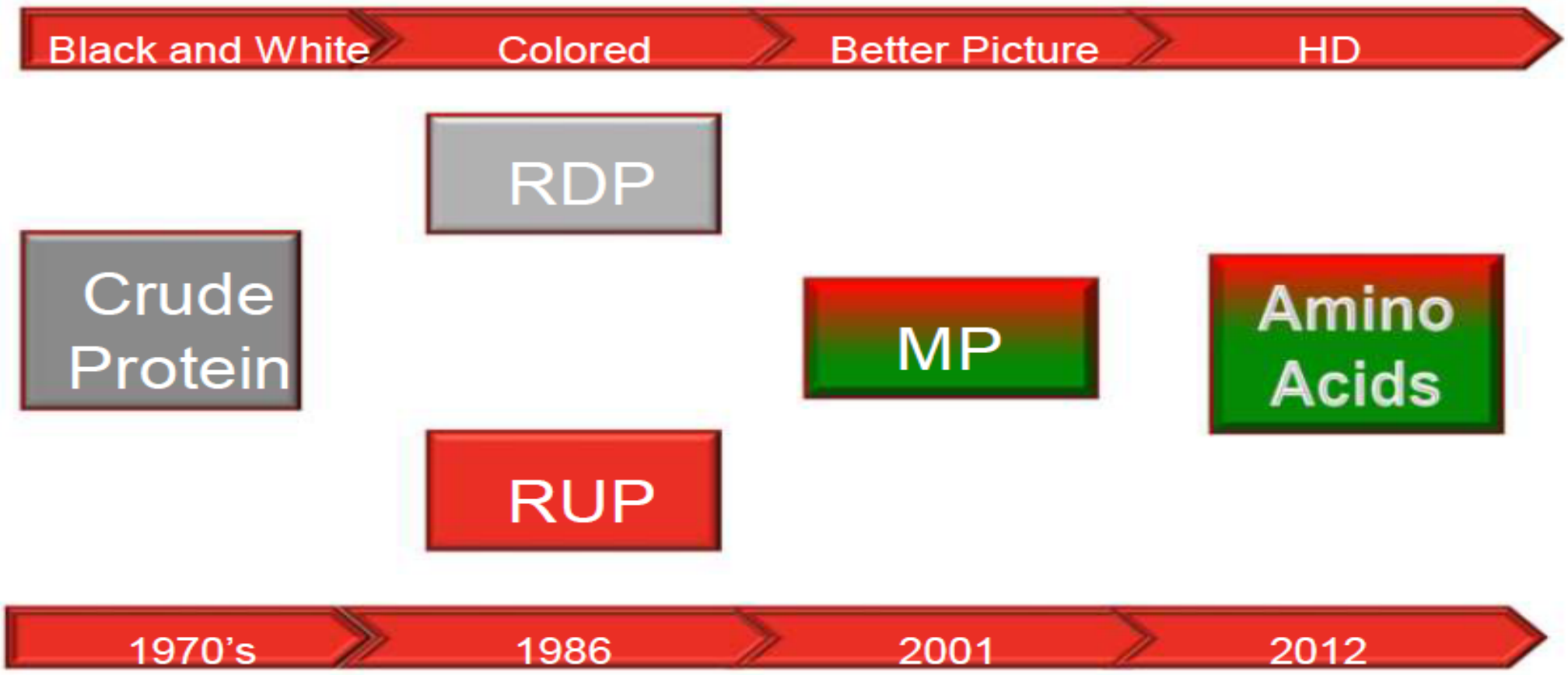
Importance: Supporting muscle development, milk synthesis, and overall health.

Dietary protein sources: Plant-based (soybean meal, canola meal) and animal-based (fish meal, dried whey).

Considerations: Formulating diets to meet protein needs while minimizing excess nitrogen excretion and environmental impact.

- In the rumen, degradable dietary proteins are degraded to ammonia and peptides.
- Between 50% and 95% of dietary protein is degraded in the rumen. With a good carbohydrate balance, most of the protein degraded will be captured by rumen microbes and be converted into microbial protein.
- In the small intestine, RUP, microbial protein and endogenous protein are digested to amino acids.
- The amino acids absorbed from the intestine are referred to as metabolizable protein (MP). The MP requirements for lactating and dry cows are in Table 4 and the dietary CP and RUP recommendations are providein Table 5 (NRC, 2001).

Protein Nutrition has Evolved Over Time



Protein Guidelines

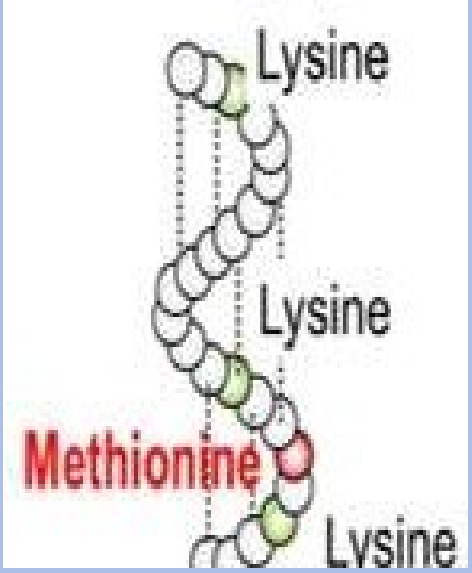
The protein requirement of dairy cows is met from feed, rumen microbes (microbial protein produced from fermentation of feeds in the rumen) and, to a lesser degree, endogenous protein. The protein in feed is either degraded in the rumen, which is referred to as rumen degraded protein (RDP), to support fermentation of feedstuffs and microbial protein growth, or it is undegraded (RUP) and "bypasses" rumen fermentation. The RUP concentration of a diet is dynamic and increases as DMI increases because faster diet passage rates through the rumen which reduces time for rumen degradation of protein

5. Dietary protein guidelines for lactating and dry cows, 1,500 lb. cow

	-Lactating cows – Stage of lactation-			--Dry cows--	
Protein fraction	Early	Mid	Late	Far-off	Close-up
CP, % of DM	17–18	16-17	15-16	12-13	13-14
RDP, % of CP	60–65	64-68	64-68	65–68	62-66
RUP, % of CP	35–40	32–36	32–36	32–35	34-38

Cows don’t have a requirement of Protein, but they require amino acids

- **Amino acids.** Cows require amino acids to meet their metabolic and production “protein” requirements. Due to the complexity of both feed protein digestion in the rumen and the production of microbial protein during rumen fermentation, absolute amino acid requirements have not been definatively established. However, based on dose response curves, recommended levels for lysine and methionine in lactating dairy cow diets are 6.6-6.8% and 2.2% of the MP or a 3:1 ratio, respectively (Schwab and Boucher, 2007).



Essential Micronutrients

- **Role:** Minerals and vitamins in various physiological functions (bone development, immune function, enzyme activation)
- **Sources:** Dietary minerals (calcium, phosphorus, magnesium) and vitamins (A, D, E, K, B-complex).
- **Importance:** Maintaining animal health and productivity.
- **Strategies:** Formulating diets for adequate levels, including supplementation and fortification.


Growel
Commitment To Quality
Nervouse System – Magnesium
Somatic Cell Count – Vit E Selenium Zinc
Coat Quality – Copper Vit E, Zinc
Live Function & Metabolism – Vit B12
Fertility – Phosphorus Manganese Copper Selenium
Appetite – Sodium Phosphorus
Milk Production & Quality – Calcium Phosphorus Sodium
Healthy Feet – Zinc
Bone Growth – Calcium Phosphorus Vit D

Vitamin Intake

7. Daily recommended fat soluble vitamin intake for lactating and dry cows (Dairy NRC, 2001; Weiss, 2007)

Vitamin	Lactating	Dry
	----------IU/day----------	
A	85,000-100,000	85,000-100,000
D	20,000-30,000	20,000-30,000
E	500	1,000*

*Supplementing 2,000-4,000 IU per day may be beneficial 2-3 weeks prior to calving.

6. General mineral guidelines for dry and lactating dairy cows

Mineral	Early lactation	Mid to late lactation	Dry cow: Far-off	Dry cow: Close-up
	% of diet DM			
Calcium	> 0.80	0.65–1.00	0.65–1.00	1.5
Phosphorus	> 0.40	0.38–0.40	0.36–0.40	0.4
Magnesium	> 0.30	0.25–0.30	0.30	0.30–0.35
Potassium	> 1.50	1.50	<1.50	< 1.3
Sodium	> 0.20	> 0.20	0.10	< 0.1
Chloride	0.30	0.30	0.15	< 0.70
Sulfur	0.20–0.25	0.20–0.25	0.20–0.25	< 0.40
Salt	0.35–0.50	0.35–0.50	0.20–0.25	0
DCAD – mEq/100g DM	25-35	25-35	—	-10 to 10
	Diet DM ppm[1]		Supplemental	
Cobalt	0.50-1.0	0.2–0.50	0.51-1.0	0.52-1.0
Copper	14-16	12-16	14-16	14-16
Iodine	0.9–1.0	0.70-0.90	0.9–1.0	0.9–1.0
Iron	0-30	0-30	0-30	0-30
Manganese	50-70	40-60	50-70	50-70
Selenium	0.3	0.3	0.3	0.3
Zinc	75-85	55-75	75-85	75-85

[1]Adapted from Zinpro Corp. and Dairy NRC, 2001.

Designing Balanced Diets

Process:

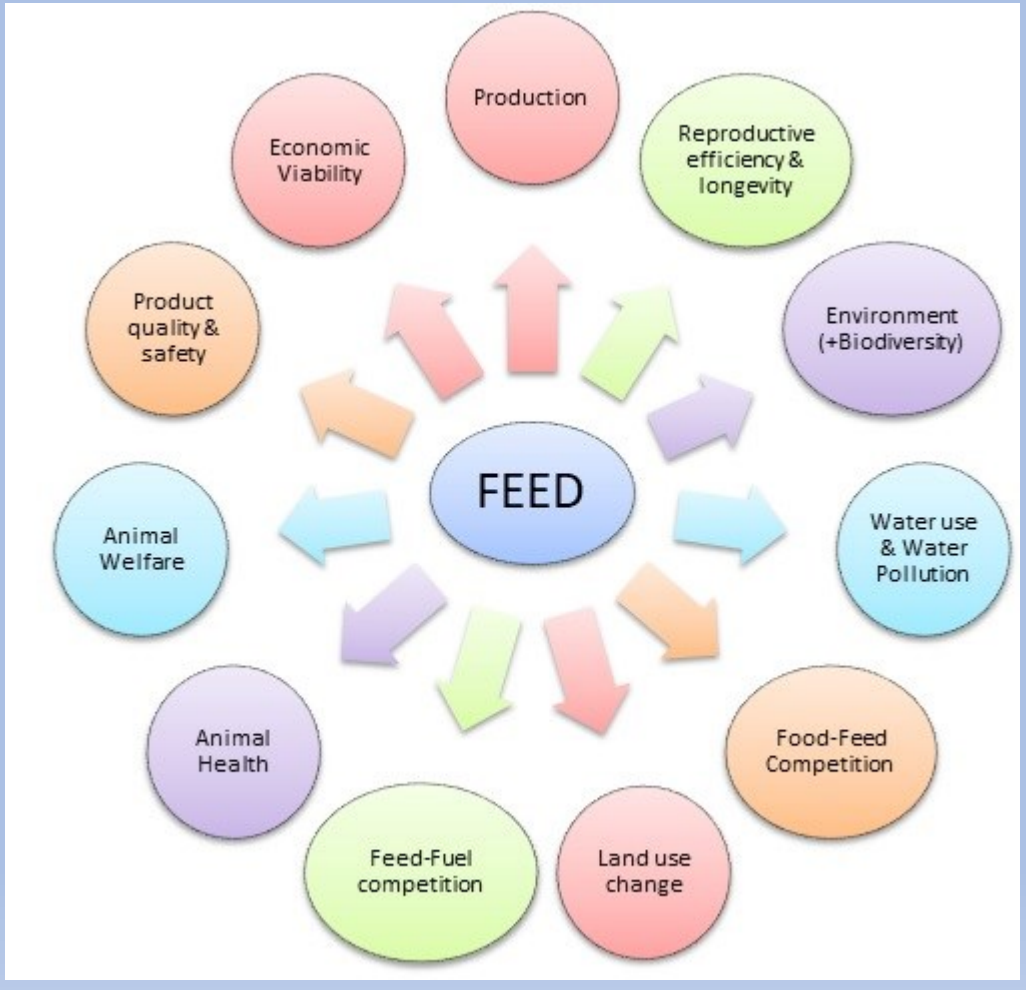
- Gather information on requirements, available ingredients, and production goals.
- Use models or software to balance rations based on nutrient needs and ingredient composition.
- Adjust ingredient proportions for desired nutrient levels and cost-effectiveness.

Factors Influencing Diet Design

Considerations:

- Feed availability and cost
- Nutrient composition of ingredients
- Palatability and digestibility
- Environmental considerations

Importance: Developing practical and sustainable feeding strategies.



Ensuring Diet Efficacy

- **Importance:** Monitoring animal performance and feed quality to evaluate diet effectiveness.
- **Techniques:** Assessing animal health, production parameters, and feed intake to identify deficiencies or imbalances.
- **Strategies:** Adjusting diets based on changes in requirements, feed availability, or environmental conditions.

Innovations in Nutrition

Overview: Emerging trends and technologies: precision feeding, nutrigenomics, alternative feed ingredients.

Potential implications: Improving feed efficiency, sustainability, and animal welfare in dairy farming.

8. Nutrient requirements of growing Holstein heifers at three ages

	Age, months			
	6	12	12*	20
Bodyweight, lb.	450	650	650	1,050
DMI, lb./day	11.6	15.4	17.2	26.7
ME required, Mcal/day	10.8	17.0	25.2	22.4
MP required, lb./day	0.92	1.25	1.30	1.52
Target gain, lb./day	1.41	2.09	2.09	1.51
ME allowable gain, lb./day	1.82	1.84	0.05	2.32
MP allowable gain, lb./day	1.55	1.93	1.96	3.46
Diet ingredients (lb. DM/day)				
Haylage	8.1	8.4	9.4	21.5
Corn silage	3.3	6.9	7.7	5.3
Soybean meal-44%	0.24	—	—	—
Dical–18% P	0.01	0.02	0.02	0.01
Diet nutrients				
MP, %	8.2	7.8	7.8	7.8
RDP, %	14.9	12.6	12.6	15.7
RUP, %	3.9	3.4	3.4	3.6
CP, %	18.8	16.0	16.0	19.3
ME, Mcal/lb.	1.04	1.04	1.04	1.01
Calcium – total %	1.05	0.89	0.89	1.15
Absorbed supplied, g	18	22	25	44
Absorbed required, g	12	16	16	15
Phosphorus, total %	0.35	0.33	0.33	0.34
Absorbed supplied, g	12	23	26	27
Absorbed required, g	9	13	13	15

10 NUTRITION TIPS YOU MIGHT BE OVERLOOKING...

1.

BALANCED RATION FORMULATION

Work with a professional nutritionist to develop a balanced ration that meets the specific nutritional requirements of your milking cows.

Consider factors such as forage quality, stage of lactation, and individual cow body condition.

2.

FORAGE QUALITY ASSESSMENT

Regularly assess the quality of your forage through laboratory analysis.

This helps ensure optimal nutrient content and allows adjustments to the ration formulation as needed.

3.

CONSISTENT FEEDING SCHEDULE

Establish a consistent feeding schedule to promote regular rumen function and optimize milk production.

Cows thrive on routine, so feed them at the same times each day. This will boost productivity and efficiency.

4.

FEED BUNK MANAGEMENT

Properly manage the feed bunk to prevent feed spoilage and wastage.

Avoid leaving feed exposed to air for extended periods, as it can lead to nutrient degradation and mold formation.

5.

FIBER SOURCE VARIETY

Include a variety of fiber sources in the ration, such as hay, silage, and straw.

This promotes rumen health, stimulates cud chewing, and enhances rumen microbial activity.

6.

ADEQUATE PARTICLE SIZE

Ensure that forages and other feed ingredients are chopped or ground to an appropriate particle size.

This allows for proper rumination and improves rumen fermentation, maximizing nutrient utilization.

7.

STRATEGIC FEEDING OF PROTEIN

Provide a balance of rumen-degradable and rumen-undegradable protein sources in the ration.

This helps maintain optimal microbial protein synthesis and supports milk protein production.

8.

ESSENTIAL FATTY ACIDS

Include sources of essential fatty acids, such as rumen-protected fats, in the ration.

These fatty acids promote reproductive health, enhance milk fat synthesis, and improve overall cow performance.

9.

TRACE MINERAL SUPPLEMENTATION

Pay attention to the inclusion of trace minerals in the ration, including copper, zinc, selenium, and manganese.

These minerals are crucial for immune function, hoof health, and reproductive performance.

10. !

WATER QUALITY

Ensure that the water provided to the cows is of good quality.

Poor water quality can affect intake, rumen function, and overall cow health.

Regularly test water for contaminants and maintain clean water sources.

Conclusion

- **Summary:** Importance of understanding nutritional requirements and formulating balanced diets for dairy animals.

- **Call to action:** Collaboration among dairy farmers, nutritionists, and researchers to optimize feeding strategies and improve dairy farm sustainability and productivity.

ANY

QUESTIONS?