PROAGRO LECTORIUM

Modern approaches to calculating diets for ruminants

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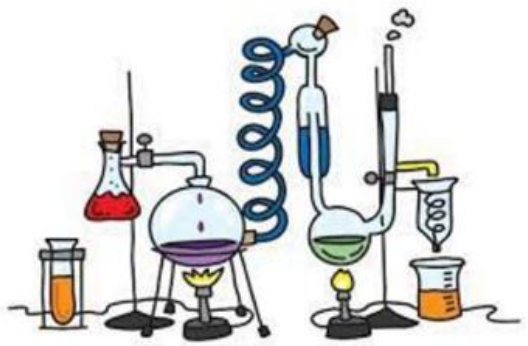
Cows on the farm

FEED → ANALYSIS → DIET → CONTROL

Analysis



Precision feeding is based on feed analysis

Wet chemistry:

- Time-consuming
- Costly
- Requires hazardous reagents
- Requires trained laboratory personnel

Near-infrared spectroscopy (NIRS)

- Quick
- Relatively inexpensive
- Does not require complex training of laboratory personnel

Dairy One: a partner laboratory

Founded in 1974

International level: more than 40 countries
NIR partner network

Dairy One
Forage Laboratory

FEED → ANALYSIS → DIET → CONTROL

Dairy One
Forage Laboratory

- More than 100,000 samples annually
  - More than 110,000 samples through NIR partners annually
- Full range of wet chemistry tests
- Near-infrared spectroscopy (NIRS)
- Water analysis
- Manure analysis

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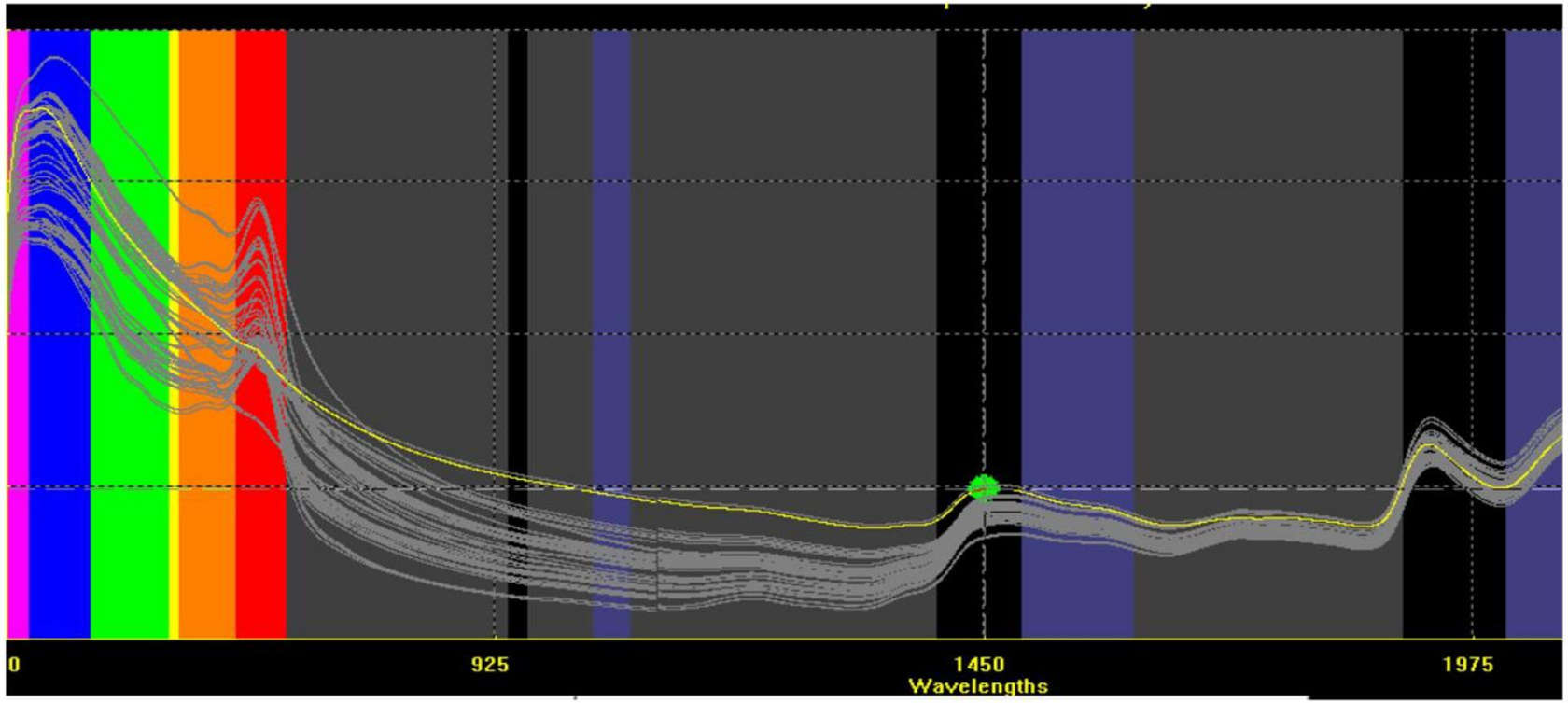


NIR

- Near-infrared spectroscopy
- The wavelength of light is associated with various nutrients
  - NIR measures the quantity of reflected light
- NIR uses the range of 1,100–2,500 nm
  - Visible spectrum: 400–700 nm

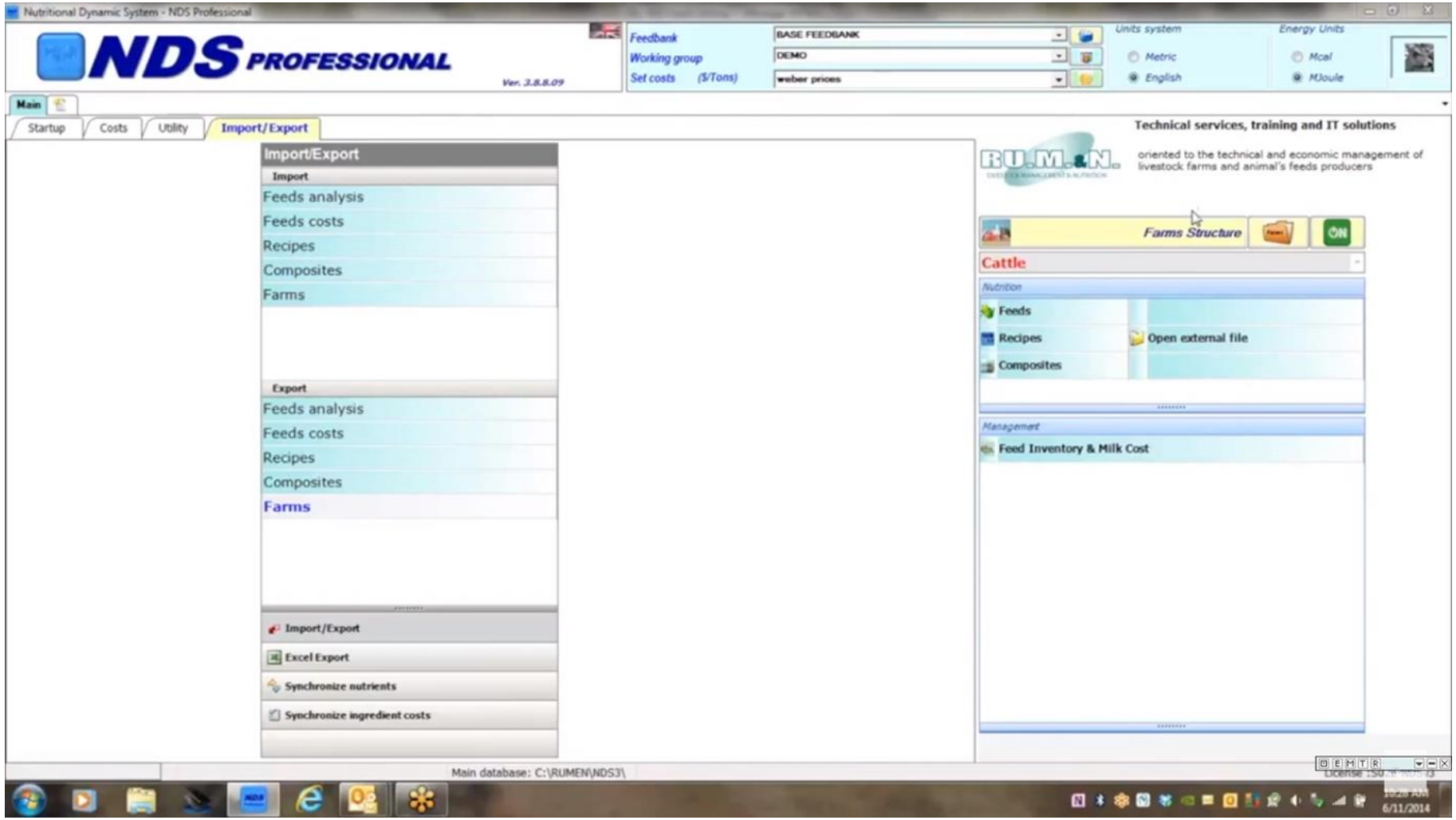
NIR limitations

- The best method for organic components
- Mineral analysis is challenging (only recognizes hydrated minerals or minerals bound to organic molecules); therefore, analysis of feed and premix mixtures is impossible
- Contaminated samples
- Abnormal samples
- Atypical samples

Analysis

<table>
<tr><td colspan="2"></td><td>Wender analysis</td><td colspan="5">Van Soest analysis</td></tr>
<tr><td colspan="2">Water and other liquid substances</td><td colspan="6">Water (moisture)</td></tr>
<tr><td rowspan="9">Dry matter (DM)</td><td>Inorganic matter</td><td colspan="6">Crude ash (CA)</td></tr>
<tr><td rowspan="8">Organic matter</td><td colspan="6">Crude protein (XP)</td></tr>
<tr><td colspan="6">Crude fat (XL)</td></tr>
<tr><td rowspan="4">Nitrogen-free extracts (NFE)</td><td colspan="3">Starch</td><td rowspan="3">Non-fiber carbohydrates (NFC)</td></tr>
<tr><td colspan="3">Sugar, pectins, etc.</td></tr>
<tr><td colspan="3">Organic residue</td></tr>
<tr><td colspan="3">Hemicellulose</td><td rowspan="4">Structural carbohydrates, neutral detergent fiber (NDF)</td></tr>
<tr><td rowspan="3">Crude fiber</td><td colspan="2">Cellulose</td><td rowspan="3">Acid detergent fiber (ADF)</td></tr>
<tr><td rowspan="2">Lignin</td><td rowspan="2">Acid detergent lignin (ADL)</td></tr>
<tr></tr>
</table>

Diet


Nutritional Dynamic System - NDS Professional
NDS PROFESSIONAL
Ver. 3.8.8.09
Feedbank
BASE FEEDBANK
Working group
DEMO
Set costs ($/Tons)
weber prices
Units system
Metric
English
Energy Units
Mcal
MJoule
Main
Startup
Costs
Utility
Import/Export
Import/Export
Import
Feeds analysis
Feeds costs
Recipes
Composites
Farms
Export
Feeds analysis
Feeds costs
Recipes
Composites
Farms
Import/Export
Excel Export
Synchronize nutrients
Synchronize ingredient costs
Technical services, training and IT solutions
R.U.M.A.N.
oriented to the technical and economic management of livestock farms and animal's feeds producers
Farms Structure
Cattle
Nutrition
Feeds
Recipes
Open external file
Composites
Management
Feed Inventory & Milk Cost
Main database: C:\RUMEN\NDS3\
6/11/2014

Model of animal, pen, farm, and productivity

Animal Inputs | <Recipe CNCPS 6.55> [Lactating Dairy Cow] | Comparisons [1] | Optimizer | P-Size | Mixer Wag

Number of animals	n	152			
Days in cycle	days	365			
Breed type		Dairy			
Primary breed		Holstein	100%		
Secondary Breed					
Average production/head/year	kg	10500			
Lactation number	n	2,50			
Calving interval	months	13,20			
Age at first calving (AOFC)	months	25,00			
Age (actual average)	months	49,00			
Mean FBW	kg	690,0		SBW kg	662,4
Mature FBW	kg	750,0		SBW kg	720,0
Days since calving (DIM)	days	120,0			
Days pregnant	days	0			
Daily milk production	kg	44,00	liters		42,59
Milk fat	% w/w	3,71	% w/v		3,83
Milk total protein	% w/w	3,22	% w/v		3,33
Milk true protein	% w/w	2,99	% w/v		3,09
Casein	% w/w	2,49	% w/v		2,57
Milk lactose	% w/w	4,87	% w/v		5,03
BCS (1-5)		2,75		BCS 30d	2,75
Target BCS		2,75			
Days to reach target BCS	days	30			
Calf birth weight	kg	41,0			
ADG	kg/day	0,126			

Model of animal, pen, farm, and productivity

Diet evaluation	Pool size	Rumen	Synchrony	Excretion	Fatty acids	Amino acids	Minerals	Vitamins	Reserves	Digestibility	Water

Mean | Details

Excretion with feces and wet manure					Feces composition					
	Total, kg	N, g	P, g	K, g		%		%		%
Dry feces	17.89				Total CHO	55.36	NDF/dietary NDF	49.57	C8	17.20
Wet feces	104.02	250.38	72.83	133.02	Starch	3.32	pdNDF/dietary pdNDF	32.84	Protein	19.28
Urine	51.23	202.82	1.44	234.25	Soluble fiber	0.61	Starch/dietary starch	4.05	Lipid	8.81
Wet manure	155.25	453.20	74.27	367.27	NDF	50.90			Ash	16.55
Consumption		676.38	112.07	430.27	uNDF	25.58				
Productive		223.18	37.80	56.70	Lignin	9.51				

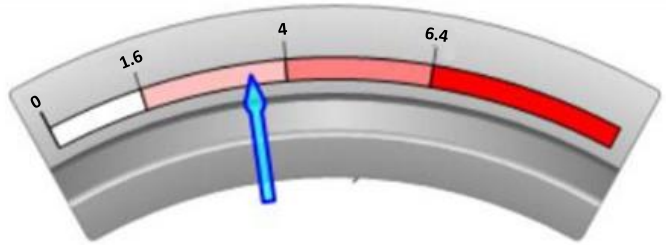
Productive N/Total N	33.0%	Productive P/Total P	33.73%	CH4 (Mcal)	6.18	CO2 (L/day)	8,118.7
Productive N/N in urine	1.10 : 1	P in manure/Total P	66.27%	CH4 (L/day)	674.8	CO2 (kg/day)	32.18
N in manure/Total N	67.00%	Productive K/Total K	13.18%	CH4 (g/day)	483.74	CO2 (kg/kg of milk)	0.35
NH3 potential	131.83	K in manure/Total K	85.36%	CP4 (g/kg of milk)	5.22	CO2 equivalents (kg/kg of milk)	0.74
					CH4		CO2

Current yield ☑

Projected yield ☐

Milk yield adjusted for fat and protein ☐

NDS rumen pH	Risks of acidosis	Volatile fatty acids	B
Minimum rumen pH	5.52		
pH <5.8, time (h/day)	4.86	<5.0 h/day	
Surface pH <5.8, pH×min/day	87.0		
Acidosis index, pH <5.8 pH×min/kg PEF	3.41	<6.4 pH×min/kg PEF	



Acidosis index = 3.41

No risks | Low risk | Moderate risk | High risk

Principles of diet calculation

- Calculation by dry matter, taking into account the cost of feed raw materials.
- Providing a sufficient amount of NDF in the diet; control of ADF content.
- Calculation taking into account the crude protein and bypass protein.
- Calculation taking into account the starch and sugar content.
- Calculation by net energy.
- Balance of Ca, Na, and K by adding individual components (in addition to premix).
- Accounting for the dietary cation-anion balance in dry and dairy cows.

Mature body weight

One of the most important parameters entered into the **NDS professional** system is the **mature body weight.**

Body weight affects various functions

- Projected feed intake
- Feed passage rate
- Nutrient requirement for growth
- Requirements during pregnancy
- Minimum reserve requirement

- Meeting the energy requirement
  - maintenance requirement
  - taking into account the productivity
  - heat exchange
- Meeting the protein requirement

Mature body weight

IMPORTANT! MATURE BODY WEIGHT

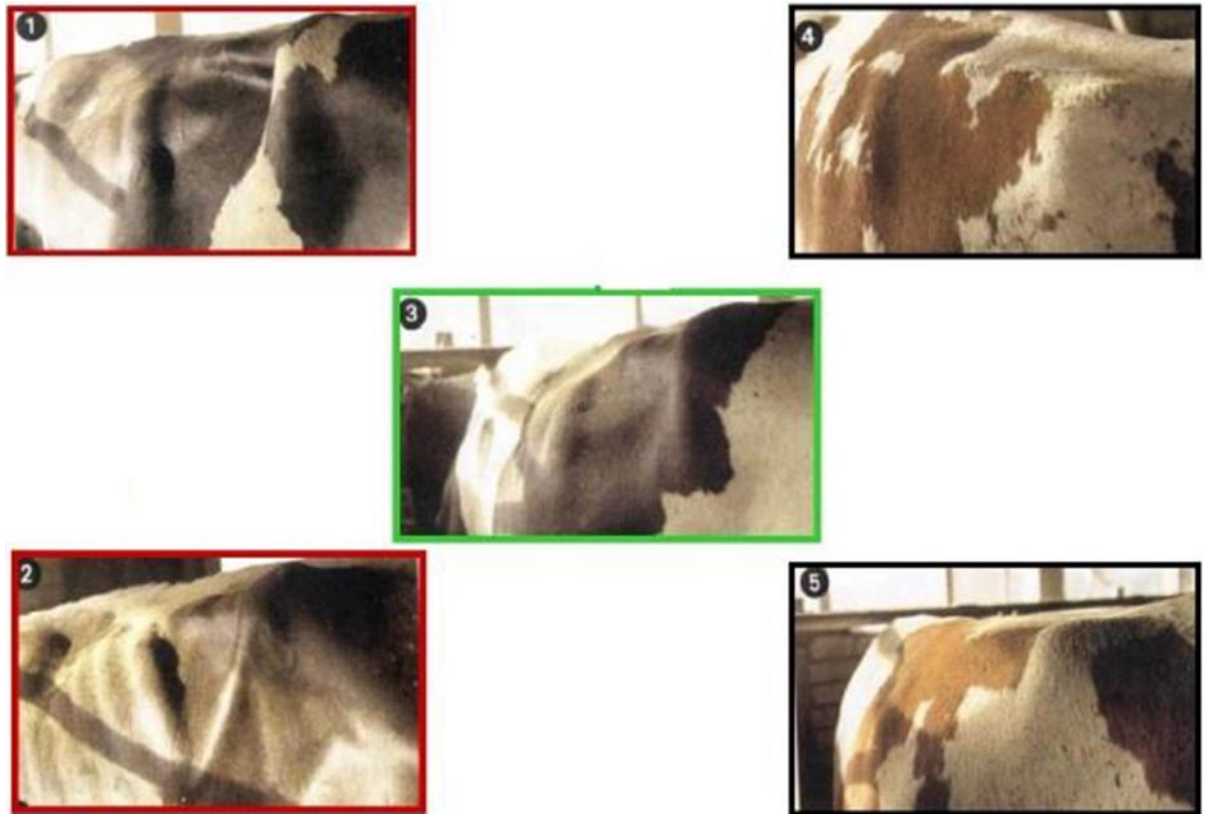
The **mature body weight (MBW)** should be measured very carefully, since the nutrition model is based on this important parameter.

The mean mature body weight for a specific farm should be determined once or twice a year. To do so, we measure the live weight of 10–20 cows after 3–4 lactations or older in the middle of lactation (120 to 180 DIM), with a body condition score of about 3 points after milking.

Control. Evaluation of left-over feed on the feed table

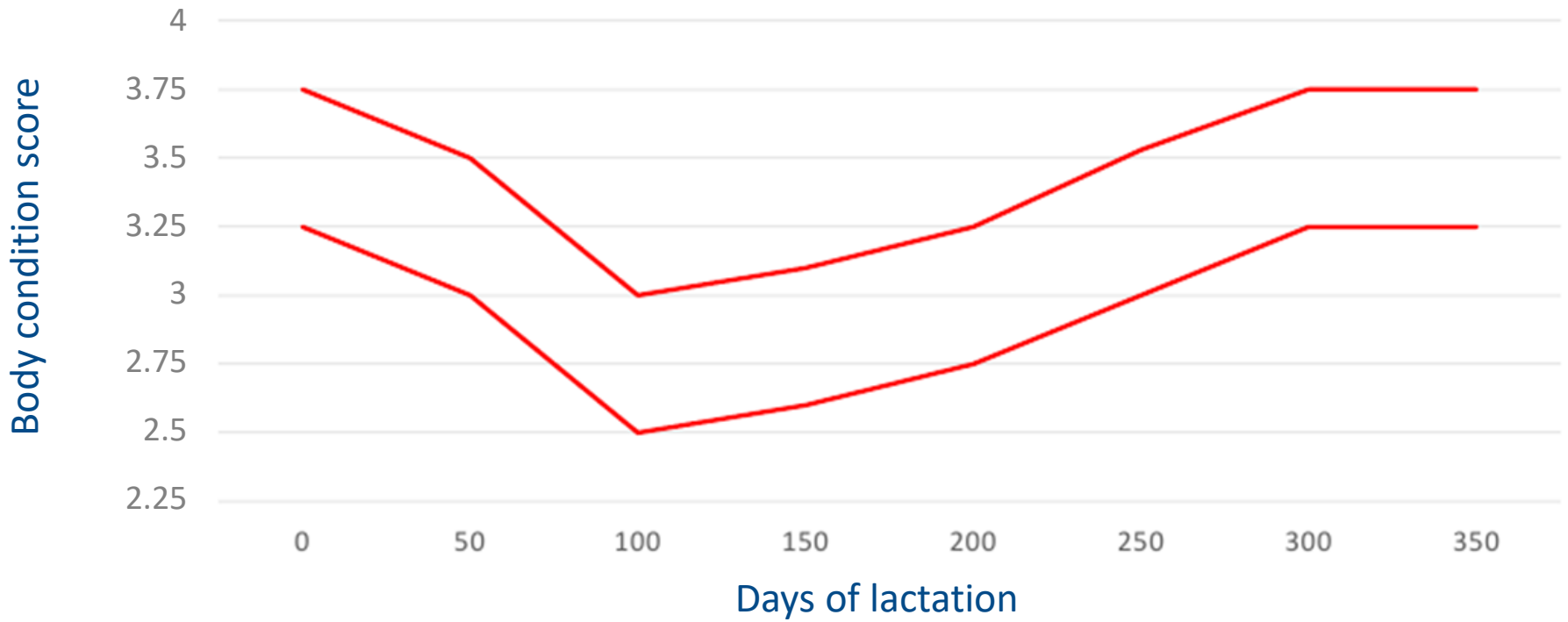
Control

Individual feed intake is monitored by determining rumen accumulation.



Body condition score (BCS)

Body condition score limits at different stages of lactation



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Control. Evaluation of feces

Grade 1

Liquid, no visible structure.

Grade 2

Liquid and mushy; leaves splashes when falling on the floor.

Grade 3

A cake is 2–4 cm thick, with rings and a depression in the center. Boot test: **no** footprint; **does not** stick to the sole.

Grade 4

A cake is dense, >4 cm thick, with rings. Boot test: footprint; sticks to the sole.

Grade 5

Solid; resembles horse feces; height 5–10 cm

Control. Cud evaluation

Consequences

- Decreased saliva production
- Increased risk of acidosis
- Decreased fat content in milk
- Liquid feces
- Increased risk of displaced abomasum (especially in newly-calved cows)

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Parameters

- Productivity corresponding to the lactation phase
- Fat content in milk 3.6–4.4%, protein content in milk 3.2–3.4%
- Milk fat/protein ratio (1.1 : 1–1.4 : 1)
- Urea content in milk (15–30 mg/100 mL)
- Body condition score (BCS)
- No diseases, good reproduction rates

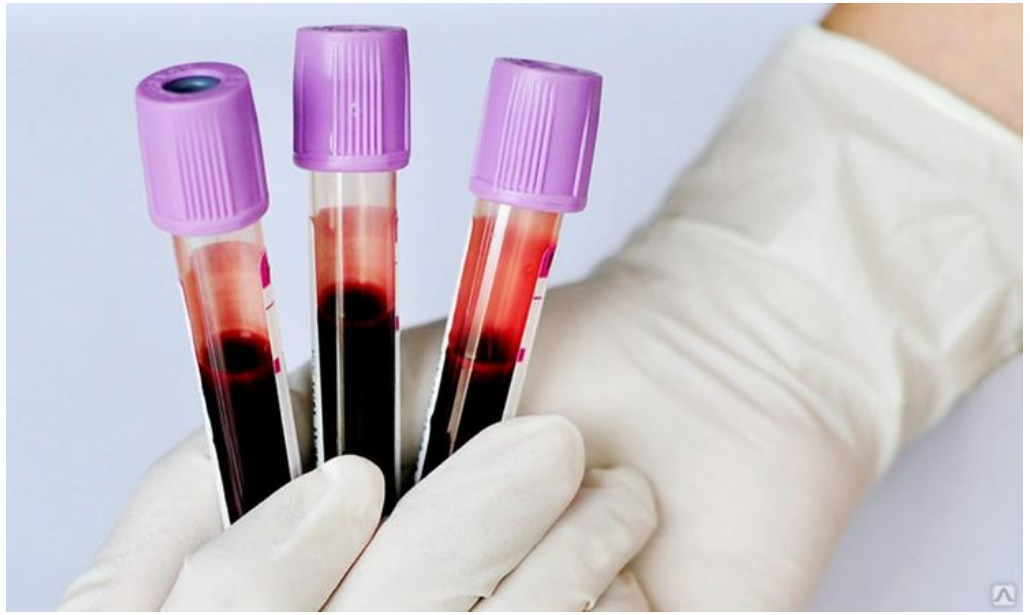
Fat/protein ratio

Limit 1.1 : 1–1.4 : 1

✓ <1.1 : 1 (due to a decrease in fat): suggests acidosis

✓ >1.4 : 1.1 (due to an increase in fat): suggests ketosis

Biochemistry



Reference biochemistry parameters of dairy cows

Parameters	Units	Reference values
Total protein	g/L	70–92
Albumins	g/L	25–36
Globulins	g/L	40–63
A/G	U	0.4–0.8
Urea	mmol/L	2.4–7.5
Creatinine	μmol/L	62–163
Glucose	mmol/L	2.0–4.8
Total bilirubin	μmol/L	1.16–8.15
Triglycerides	mmol/L	0.09–0.37
Alkaline phosphatase	IU/L	31–163
Ca	mmol/L	2.06–3.16
P	mmol/L	1.13–2.91

Biochemistry of cow urine

Parameters	Range
pH	7.0–8.7
Ketone bodies, mg%	9–10
Ammonia nitrogen, % of total urine nitrogen	0.4–2.5
Urea nitrogen, % of total urine nitrogen	40–72
Amine nitrogen, % of total urine nitrogen	0.5–2.5
Test for: Protein	Negative
Sugar	Negative
Histamine	Negative

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Thank you!

Please email your questions and comments to yuliyguseva@yandex.ru.