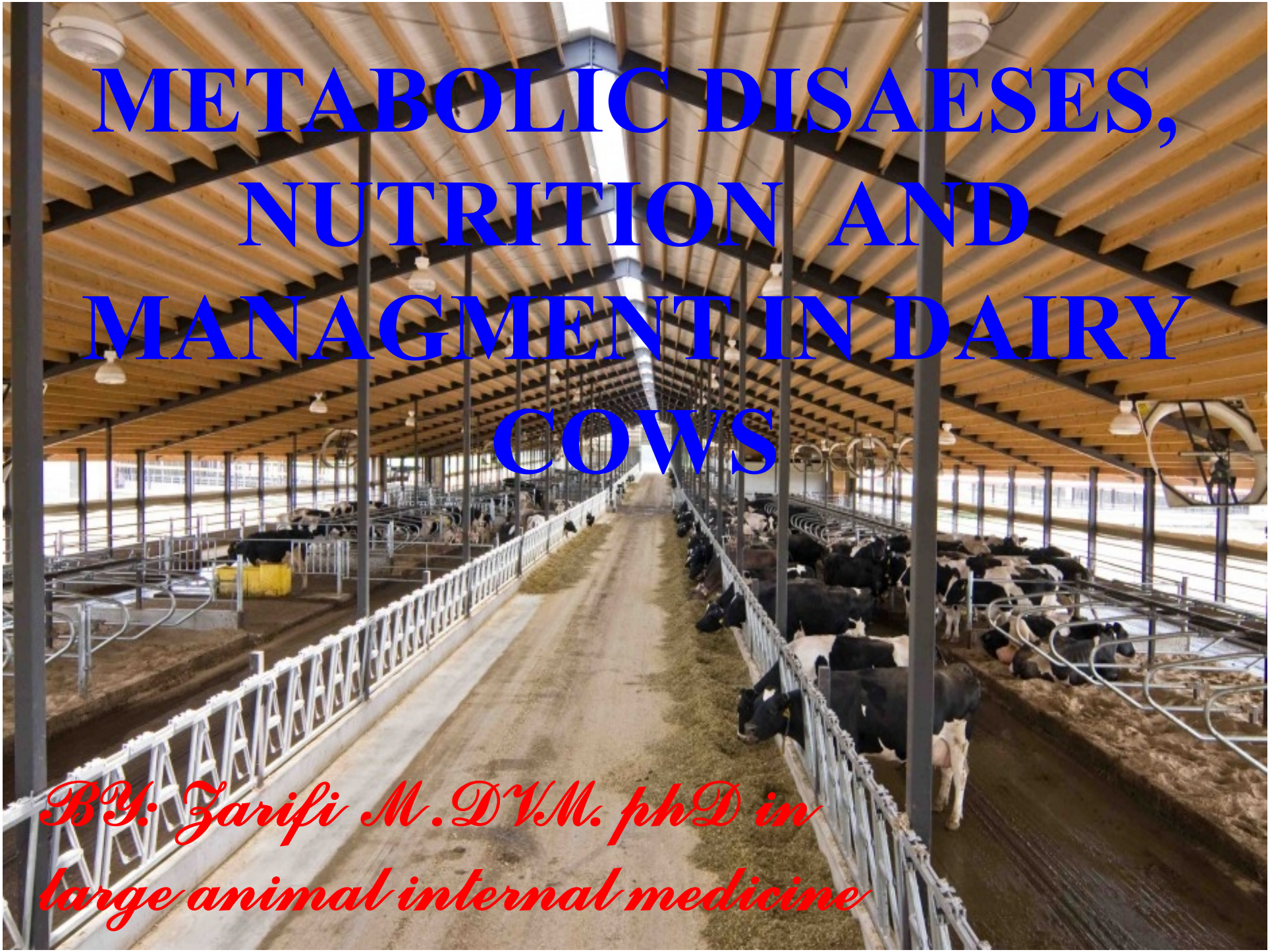

“Nothing can be taught to a man; but it’s possible to help him find the answer within himself."
(Galileo Galilei)



METABOLIC DISAESES, NUTRITION AND MANAGMENT IN DAIRY COWS

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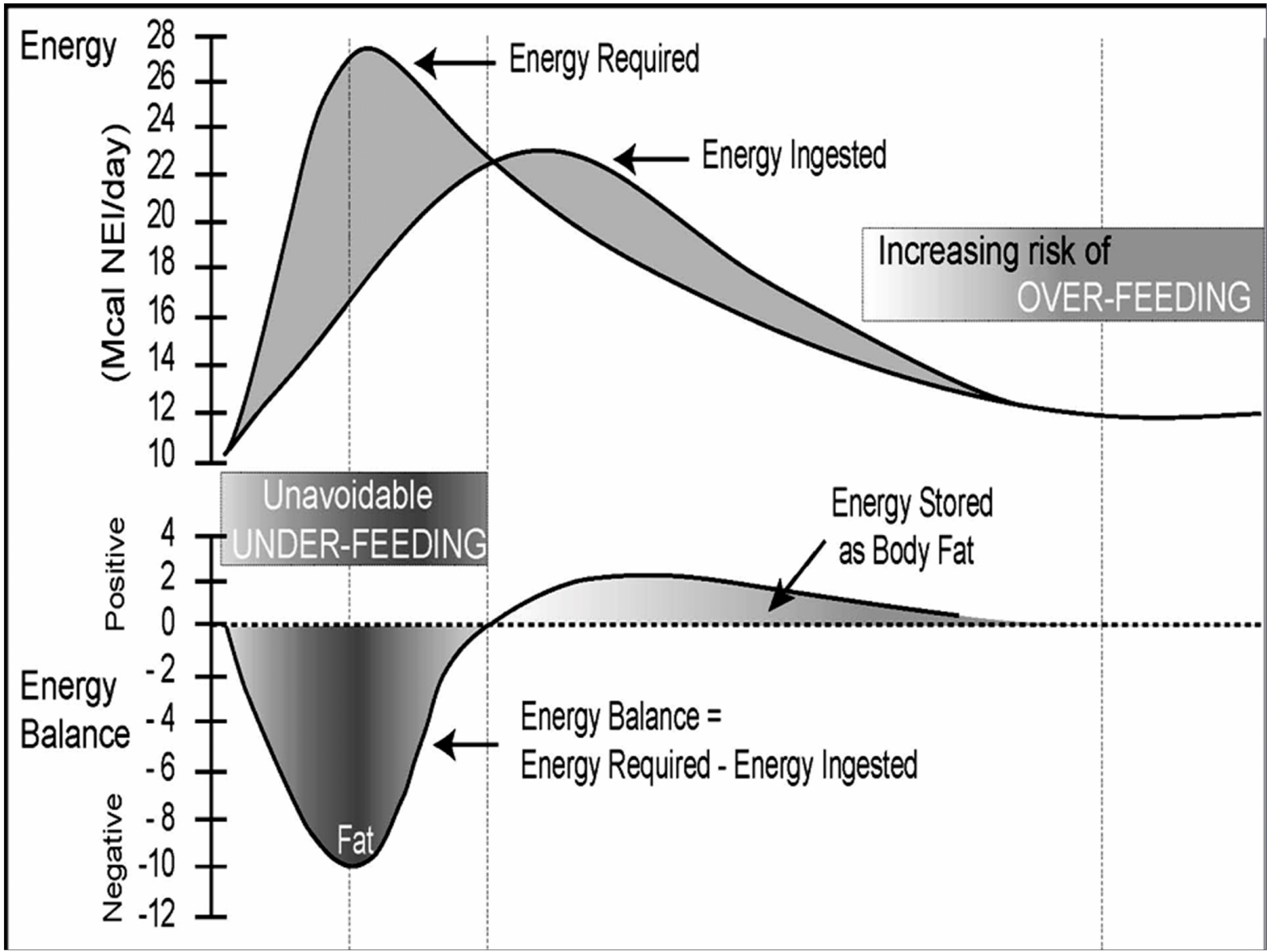
بسم الله الرحمن الرحيم

Lactation cycle in dairy cows


Energy
(Mcal NEI/day)
28
26
24
22
20
18
16
14
12
10
Energy Required
Energy Ingested
Increasing risk of
OVER-FEEDING
Unavoidable
UNDER-FEEDING
Energy Stored
as Body Fat
Positive
4
2
0
Energy
Balance
-2
-4
-6
-8
-10
-12
Negative
Energy Balance =
Energy Required - Energy Ingested
Fat

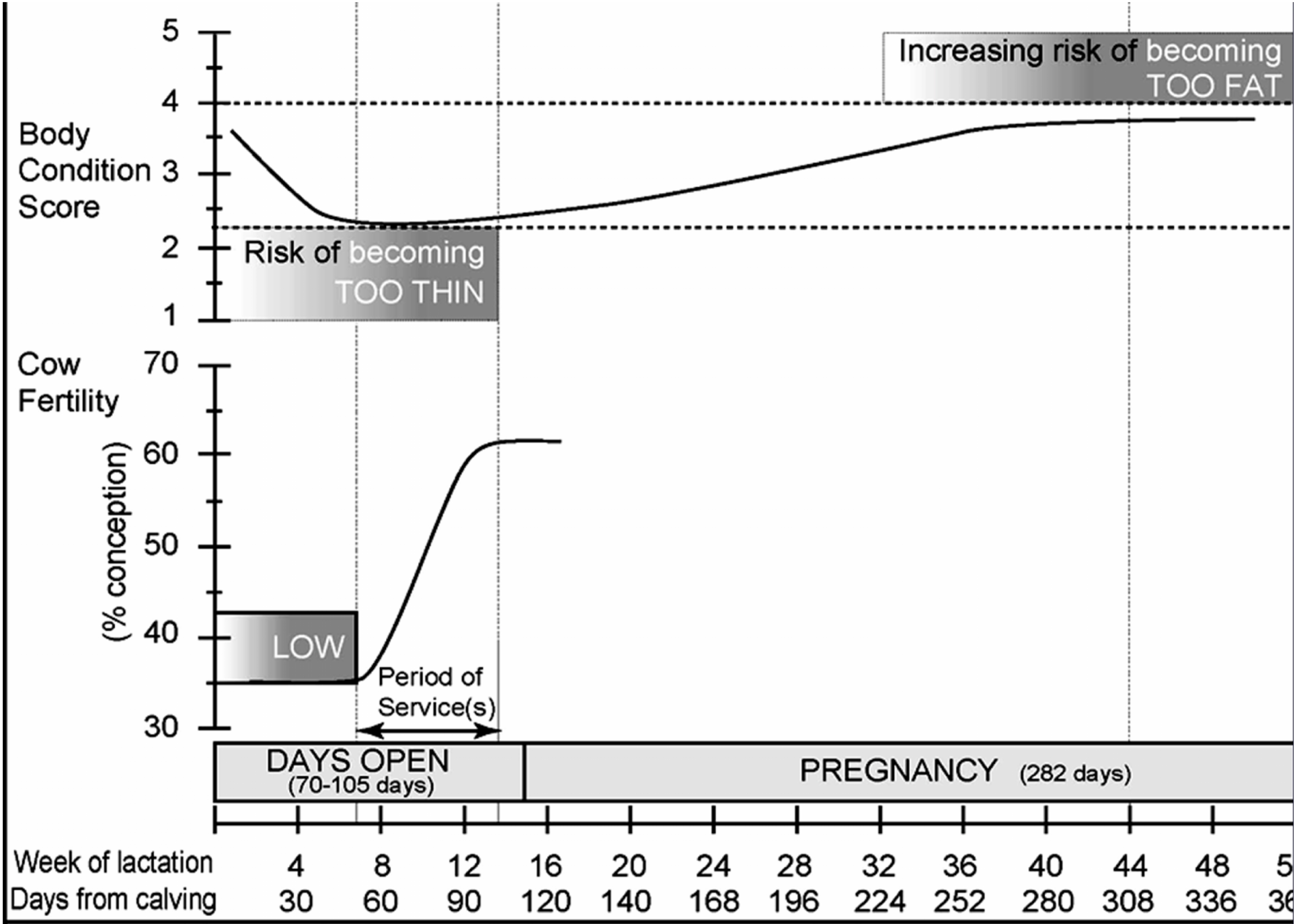
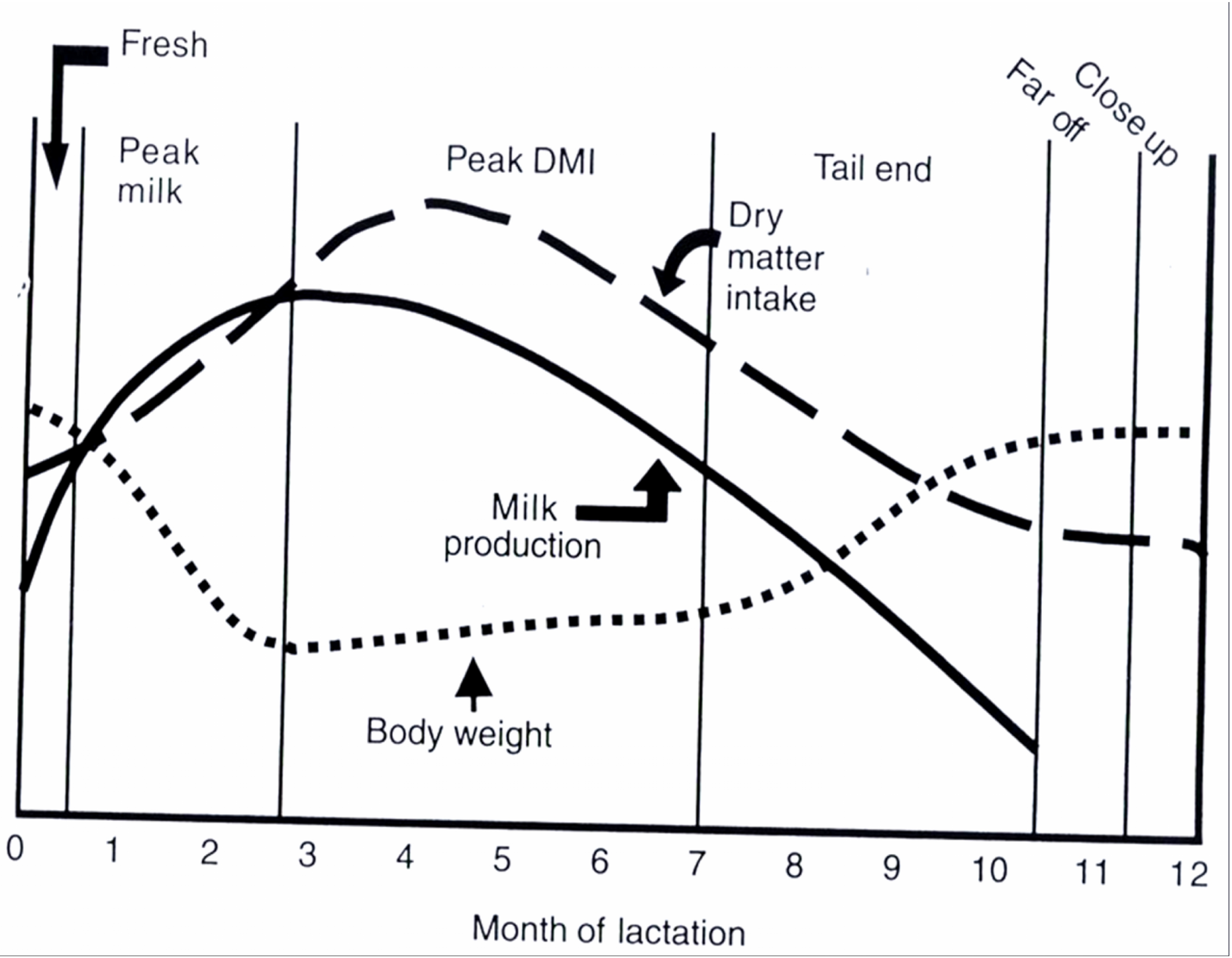
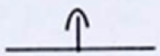
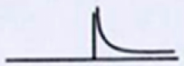
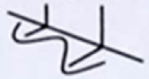
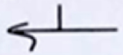
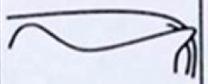
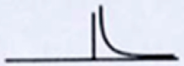
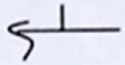
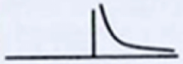
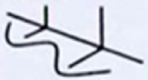
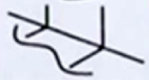
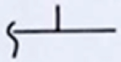
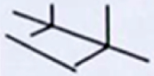
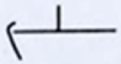
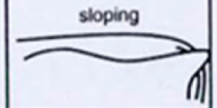
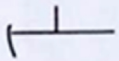
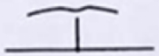
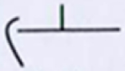
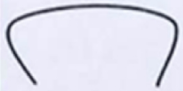


Figure 1: Energy balance of dairy cows in early lactation


Fresh
Peak milk
Peak DMI
Tail end
Dry matter intake
Far off
Close up
Milk production
Body weight
0
1
2
3
4
5
6
7
8
9
10
11
12
Month of lactation

	SCORE	Spinous processes (SP)	Spinous to Transverse processes	Traverse processes	Overhanging Shelf	Tuber Coxae (hooks) & Tuber ischii (pins)	Between hooks and pins	Between the hooks	Tailhead to pins
Severe Under conditioning	1.00	Individual processes distinct, giving a saw tooth appearance 	deep depression 	very prominent, >1/2 length visible 	definite shelf, gaunt, tucked 	extremely sharp, no tissue cover 	severe depression, devoid of flesh	severely depressed 	prominent with deep "V" shaped cavity under tail 
	1.25								
	1.50								
	1.75			1/2 length of process visible					bones prominent "U" shaped cavity formed under tail
Frame obvious	2.00	Individual processes evident 	obvious depression 		prominent shelf 	prominent	very sunken		
	2.25			between 1/2 to 1/3 of process visible					
	2.50	Sharp prominent ridge			moderate shelf		thin flesh covering 	definite depression 	first evidence of fat
	2.75		Smooth concave curve 	 < 1/4 visible					bones smooth, cavity under tail shallow & fatty tissue lined
Frame & covering well balanced	3.00				slight shelf 	smooth	depression	moderate depression	
	3.25		 smooth slope	appears smooth, TP's just discernable					
	3.50	smooth ridge, the SP's not evident		individual processes discernable 		covered	slight depression	slight depression	
	3.75						sloping 		bones rounded with fat and slight fat-filled depression under tail 
	4.00	flat, no processes discernable	Nearly flat 	smooth round edge	none 	rounded with fat			
Frame not as visible as covering	4.25						flat	flat	bones buried in fat, cavity filled with fat forming tissue folds
	4.50			edge barely visible		buried in fat 			
	4.75	buried in fat	rounded (convex)	buried in fat	bulging		rounded	rounded	
Severe over conditioning	5.00								

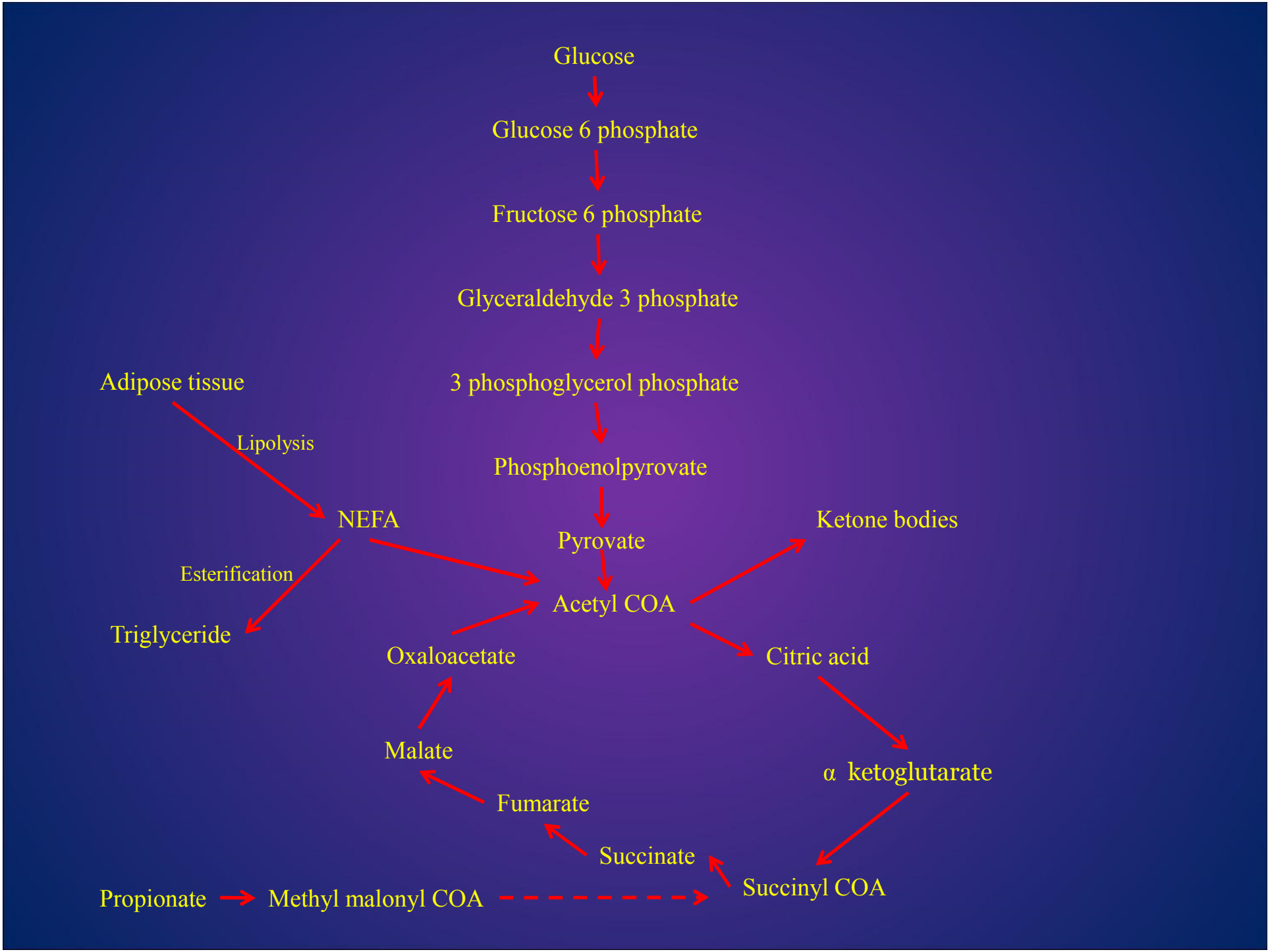
Ketosis (Acetonemia)

Etiology

A multifactorial disorders of energy metabolism. Negative energy balance results in hypoglycemia and ketonemia.

- Glucose metabolism in ruminants (propionate and amino acids)
- Energy balance and lipolysis
- Hepatic insufficiency in ketosis (Type 1 or spontaneous ketosis and type 2 ketosis)
- Role of insulin and glucagon (indirectly somatotropin)
- Ketone formation
- Individual cow variation
- Types of bovine ketosis

- Primary ketosis (Production ketosis)
- Secondary ketosis
- Alimentary ketosis
- Starvation ketosis
- Ketosis due to specific nutritional deficiency


Glucose
Glucose 6 phosphate
Fructose 6 phosphate
Glyceraldehyde 3 phosphate
3 phosphoglycerol phosphate
Adipose tissue
Lipolysis
Phosphoenolpyrovate
NEFA
Pyrovate
Ketone bodies
Esterification
Acetyl COA
Triglyceride
Oxaloacetate
Citric acid
Malate
α ketoglutarate
Fumarate
Succinate
Propionate
Methyl malonyl COA
Succinyl COA

Epidemiology

- Lactational incidence rate 0.2% – 10%
- Subclinical ketosis 40%
- First month of lactation
- Age
- BCS
- Season
- Long dry period, twining, LDA

Pathogenesis

- Hypoglycemia and ketonemia
- Decrease milk yield
- Nervous signs
- Immunosuppression
- Decrease reproductive performance

Clinical findings

- Wasting form and nervous form
- Unusual appetite loss
- Weight loss rapidly
- Woody appearance
- Dry and firm feces
- May be decreased in ruminal movements
- Spontaneously recovery
- Ketone odor
- Circling, head pressing, blindness, Aimless wandering, Chewing movements, bellowing, hypersthesia
- Subclinical ketosis (Laboratory diagnosis, milk production, reproduction)

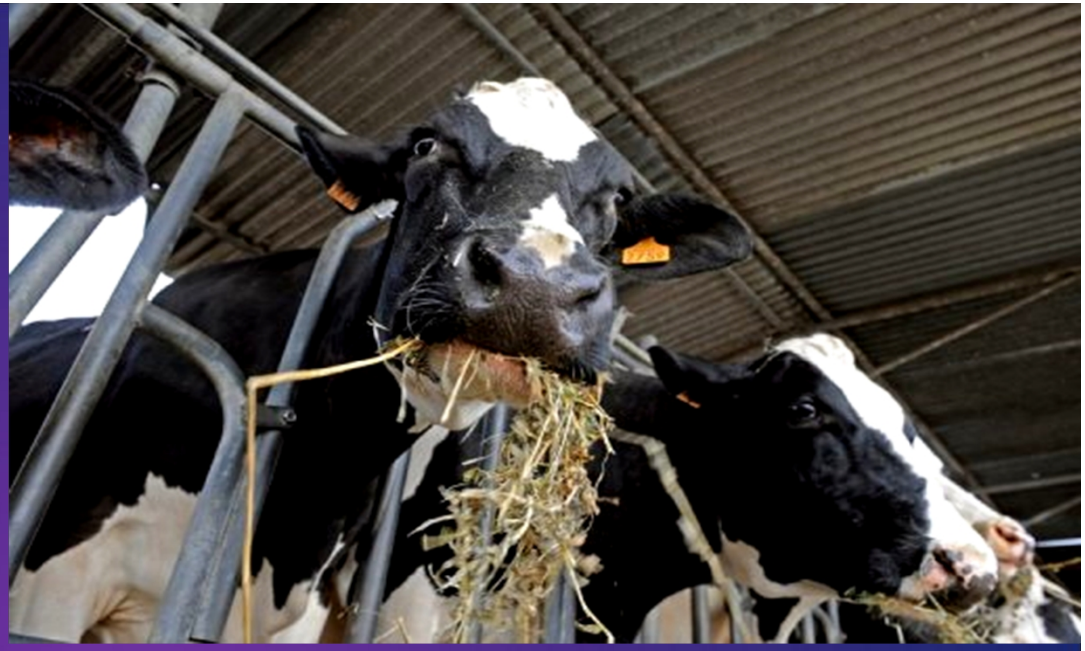
Clinical pathology

- Glucose (20-40 in primary ketosis , above 40in secondary ketosis)
- Blood ketones (normal<1000, Subclinical>1400, clinical 2500)
- Milk and urine cowside tests (acetone and acetoacetate with sodium nitroprusside)
- Milk testing (BHBA and SNP)
- Urine testing (BHBA and SNP)
- Milk/fat ratio
- Liver enzymes, liver biopsy, NEFAs, Cholesterol, bilirubin,

Treatment

- Replacement therapy (Glucose, Other sugars, propylene glycol and glycerol, other glucose precursors)
- Hormonal therapy (Glucocorticoids, Insulin, Anabolic steroids, B12, Cysteamine and sodium fumarate, Glucagon)

Control



- Dry matter intake
- Fiber digestibility
- Particle size distribution
- Energy density
- Protein content
- Feeding system
- Rumen size
- Ensilage, poor quality roughage, exercise, Minerals
- Energy supplements (propylen glycol, glycerol, propionic acid and its salts, ionophores, niacin, Cholin)
- Herd monitoring (glucose and BHBA , BCS)

Fatty liver in cattle (Fat cow syndrome, Hepatic lipidosis, Pregnancy toxemia in cattle)

Fatty liver is a major metabolic disease of dairy cows in early lactation and is associated with decreased health status and reproductive performance.

Etiology

- Negative energy balance and fat mobilization in early lactation
- Excess lipids are stored as triacylglycerol in the liver
- Liver damage and failure of liver function

Epidemiology

- High producing dairy cattle
- Fat cows
- Mild (<20% or <50mg/g), moderate (20-40% or 50-100mg/g), sever (>40% or >100mg/g), 1week after parturition
- Ketosis, LDA, mastitis, RP, milk fever and downer cow syndrome
- In about 30% of high producing cows the infiltration is sever and is associated with reversible but significant effects on liver structure and function.
- Long dry period and high BCS
- Non- lactating dairy cows and pregnancy toxemia in beef cattle
- Reproductive performance

Pathogenesis

Negative energy balance, hormonal changes, fat mobilization, NEFAs, triacylglycerol, lipoprotein, liver damages, gluconeogenesis failure, hypoglycemia and ketonemia, sever cases unreversible and die, immunosuppression, reproduction

Clinical findings

- Milk fever, LDA, RP, indigestion, dystocia
- BCS>5 or 5.5
- Not respond to treatment of other diseases
- Anorexic, Rumen contraction are weak or absent and scant feces
- Sever ketosis and not respond to treatment
- Recumbent and die in 7-10 days
- Nervous signs
- In cattle with moderately sever fatty lever, the clinical findings are much less sever and most will recover if they to eat even small amount of hay.
- Subclinical, reproductive failure, milk fever, unresponsive ketosis

Clinical pathology

- Serum biochemistry (GGT, AST, SDH, glucose)
- Milk ketone
- Liver biopsy (histological and biochemical methods, specific gravity)

Water	1	F	S	S	S
Copper sulfate	1.025	F	F	S	S
Copper sulfate	1.055	F	F	F	S
		>34%	25-34%	13-25%	<13%

- Ultrasonography
- Leukopenia, neutropenia and lymphopenia in subclinical fatty liver

Treatment

- The prognosis of sever (3 days anorexic) and nervous fatty liver is poor
- Palatable feeds and supportive therapy (Fluids and electrolytes and glucose IV and oral, rumen juice, glucagon, glucocorticoids, propylene glycol, insulin)

Control

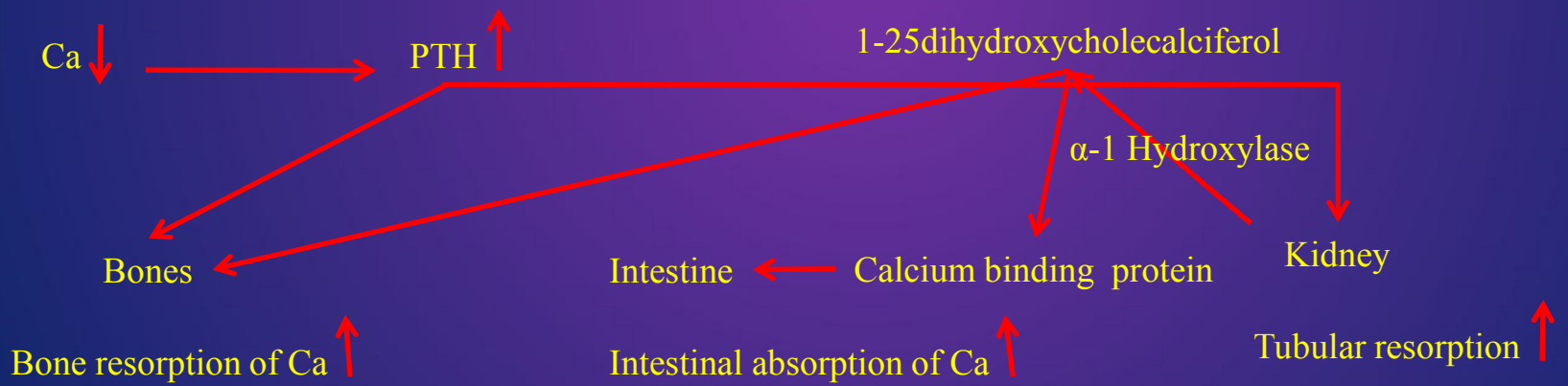
- Dry matter intake and energy balance in the transition period
- Close-up ration
- Glucogenic precursors
- Monensin
- Body condition scoring

Parturient paresis (Milk fever)

A disease of cattle, sheep and goat occurring around the time of parturition and caused by hypocalcemia and characterized by weakness, recumbency and ultimately shock and death.

Etiology

- A depression of the levels of ionized calcium
- Dry period and low requirement and lactation



Epidemiology

- Age
- Breed
- Individual
- Time of occurrence (calcium cycler)
- Stressors
- Non related to parturition
- Subclinical hypocalcemia (total plasma calcium <1.9) 50%
- BCS
- Dietary calcium
- Dietary phosphorus
- Dietary cation-anion difference = (Na + k) _ (Cl + S)
- Milk fever relapses, downer cow syndrome, Dystocia and uterine prolapse, RP, mastitis, metritis, LDA, Milk production, body weight, culling

Pathogenesis

- Hypocalcaemia (normal 2.1-2.6, subclinical<1.8, clinical 1.25-0.5)
- Atony of skeletal muscles
- Reduction of stroke volume
- Reduction of arterial blood pressure
- Reduction in ruminal and abomasal tone and motility
- Hypomagnesemia
- Hypophosphatemia

Clinical findings

- Stage 1 (Excitement, hypersensitivity, tremor, teeth grinding, no eat, stiffness of the hind limbs, ataxia)
- Stage 2 (Sternal recumbency, depression, temperature is subnormal and cool extremity, HR >80, Weak pulse, PLR incomplete or absence, ruminal stasis and secondary bloat, no anal reflex)
- Stage 3(Lateral recumbency, complete flaccidity, heart sound inaudible and HR>120)

Clinical pathology

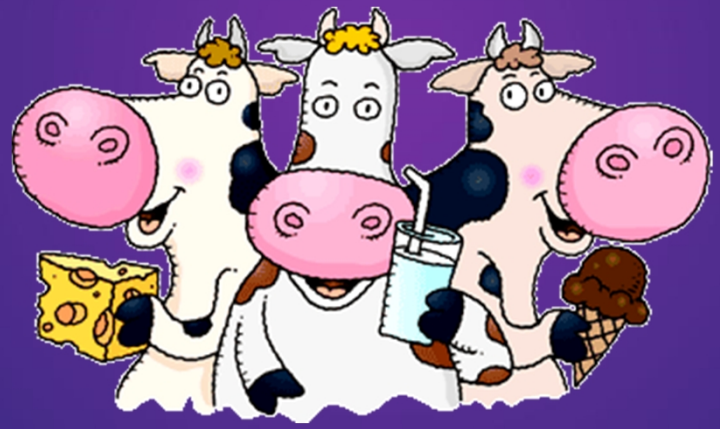
- Total serum calcium level and ionized calcium in whole blood
- Mg and P
- CPK and AST

Treatment

- As soon as possible
- Sternal and bedding and environmental condition
- Calcium borogluconate 800-1000 ml 25%
- Infusion rate and routs of administration
- Typical response
- Unfavorable response
- Failure to respond to treatment (polypharmacy)

Control

- Calcium and phosphorus restriction
- Calcium and phosphorus ratio in diet
- Binding dietary calcium
- Acidifying rations
  - DCAD mEq/100gDM = {(%Na/0.023)+(%K/0.039)}_{(%Cl/0.0355)+(%S/0.016)}
- Calcium gel dosing
- Vit D3



Sub acute ruminal acidosis (SARA)

Compton metabolic profile test

The Compton metabolic profile is based on the concept that the laboratory measurement of certain components of the blood will reflect the nutritional status of the animal, with or without the presence of clinical abnormality.

- Cut of point and alarm level
- Non-esterified fatty acids (NEFAs)
- Serum ß- hydroxybutiric acid (BHBA)
- Blood glucose
- Protein nutrition and metabolism
- Serum albumin
- AST, GGT, SDH, bilirubin
- PCV, Hemoglubolin
- Macrominerals (P, Ca, Na, K, Cu, Mg) and Microminerals
- Globulin (gamma globulin, haptoglobulin)
- Thyroxin
- GSHPx (SOD, intercellular thiol groups in erythrocytes ,paraoxonase)

- Cholesterol and triglycerid
- Vitamins
- Rumen fluid pH

- Sampling

- Timing of blood tests in relation to feed changes, feeding and calving pattern
  - Early lactation: between 10 and 20 days of lactation
  - Mid lactation: between 50 and 120 days of lactation
  - Dry period: between 7 and 10 days of calving

- background information
- Body condition score (BCS)

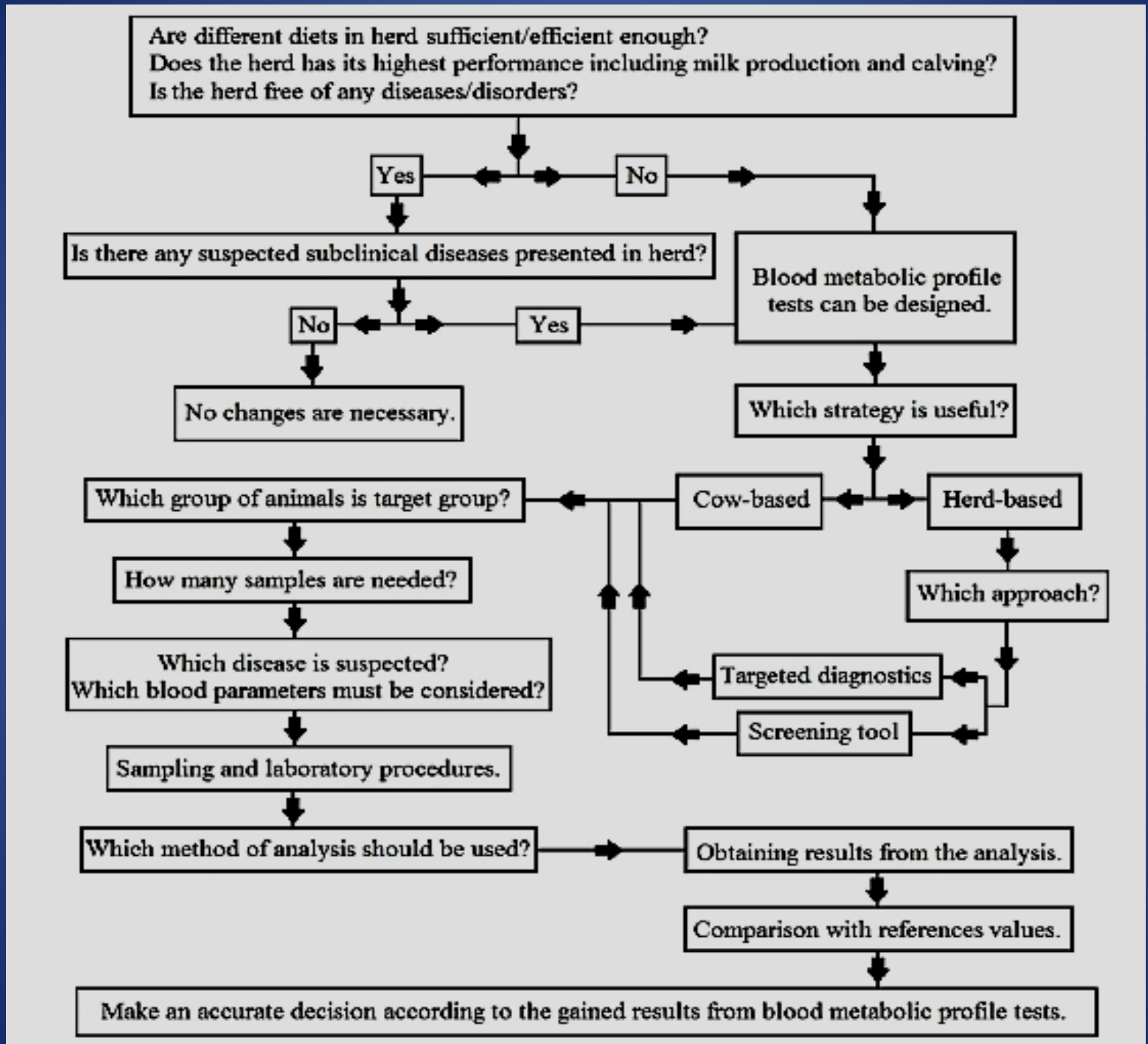

Are different diets in herd sufficient/efficient enough?
Does the herd has its highest performance including milk production and calving?
Is the herd free of any diseases/disorders?
Yes
No
Is there any suspected subclinical diseases presented in herd?
Blood metabolic profile tests can be designed.
No
Yes
No changes are necessary.
Which strategy is useful?
Which group of animals is target group?
Cow-based
Herd-based
How many samples are needed?
Which approach?
Which disease is suspected?
Which blood parameters must be considered?
Targeted diagnostics
Screening tool
Sampling and laboratory procedures.
Which method of analysis should be used?
Obtaining results from the analysis.
Comparison with references values.
Make an accurate decision according to the gained results from blood metabolic profile tests.

Table 2. Metabolic profile normal ranges for analytes from select sources

Source	Animal Class	Albumin g/dL	Urea mg/dL	Cholest. mg/dL	Glucose mg/dL	NEFA mEq/L	BHBA mg/dL
Merck[1]	Cattle[7]	2.8-3.9	7.8-25	62-193	-	-	-
Zinpro[2]	Cattle[7]	2.7-4.7	9-20	80-230	-	-	-
TVMDL[3]	Close-up	3-3.6	9.4-16.6	39-123	51-65	< 0.6	-
	< 14 DIM	3-3.6	9.4-16.6	39-123	51-65	< 0.6	-
Penn St.[4]	Close-up	3.3-3.7	-	65-114	51-74	0.03-0.16	1.25-4.2
	Fresh	3.2-3.6	-	63-253	42-68	0.01-0.52	1.7-8.9
	Concern level, fresh	-	-	-	-	-	-
Oregon St.[5]	Dairy[8]	3.2-4.1	8-27	43-331	51-77	0.04-0.34	3.42-7.62
Puls[6]	Cattle[7]	2.7-4.7	5-20	80-230	40-80	-	-
Average	All	3-4	8.1-20.9	58.9-199.6	47.7-71.5	0.03-0.5	2.1-6.9
Range	All	2.7-4.7	5-27	39-331	40-80	0.01-0.6	1.25-8.9

[1]Merck Veterinary Manual, 2011.
[2]Zinpro Performance Panel, 2011.
[3]Sprowls, personal communication.
[4]Penn State University, 2011.
[5]Oregon State University, 2011.
[6]Puls, 1989.
[7]Profile for cattle, not specific for breed.
[8]Profile specific for dairy cattle.

Table 1. Metabolic profile normal ranges for minerals from select sources

Source	Animal Class	Ca mg/dL	P mg/dL	Mg mEq/L	K mEq/L	Na mEq/L	Cl mEq/L
Merck[1]	Cattle[7]	8.4-11	4.3-7.8	1.7-3	4-5.8	125-148	96-109
Zinpro[2]	Cattle[7]	8-11	5-7	1.8-3.5	3.9-5.8	135-150	97-111
TVMDL[3]	Close-up	8.3-9.7	4.9-7.1	1.5-2.1	4-5	139-147	99-107
	< 14 DIM	8-10	4.9-7.1	1.5-2.1	4-5	138-146	97-105
Penn St.[4]	Close-up	-	-	-	-	-	-
	Fresh	8.7-11	4.5-8	2-3.5	3.8-5.2	137-148	-
	Concern level, fresh	< 8	< 3.5	< 1.5	< 3, > 5.5	137-148	-
Oregon St.[5]	Dairy[8]	8.2-10	5.2-7.9	2-3.9	3.8-5.2	137-148	-
Puls[6]	Cattle[7]	8-11	4.5-7	1.8-3.5	3.9-5.8	135-150	97-111
Average Range	All	8.2-10.5	4.8-7.4	1.8-3.1	3.9-5.4	135.1-148.1	97-108.8
Range	All	8-11	4.3-8	1.5-3.9	3.8-5.8	125-150	96-111

[1]Merck Veterinary Manual, 2011.
[2]Zinpro Performance Panel, 2011.
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Table 1. Proposed guidelines for fresh cow mean or pooled sample interpretation. Parenthesis indicate mean analyte value (70% confidence interval).

Analyte	Units	0% Abnormal Values in Pool	20% Abnormal Values in Pool	40% Abnormal Values in Pool
Albumin	g/dL	3.85 (3.77-3.92)	3.68 (3.57-3.70)	3.51 (3.38-3.63)
AST	IU/L	93.8 (88.8-98.7)	99.3 (91.8-106.7)	104.7 (94.9-114.6
BHB	mg/dL	5.21 (4.3-6.2	9.03 (7.6-10.4)	12.84 (11.0-14.7)
Calcium	mg/dL	9.67 (9.59-9.79)	8.68 (8.37-8.99)	7.68 (7.16-8.20)
Glucose	mg/dL	60.2 (58.6-61.9)	56.9 (54.7-59.1)	>53.7 (50.9-56.4)
Magnesium	mg/dL	2.54 (2.49-2.60)	2.33 (2.23-2.42)	2.11 (1.97-2.24)
NEFA	mEq/L	0.299 (.263-.336)	0.454 (.397-.512)	0.609 (.531-.687)
NEFA:Chol. Ratio	mmol/L:mmol/L	0.116 (.098-.134)	0.215 (.181-.250)	0.315 (.264-.365)
Urea N	mg/dL	17.83 (16.9-18.8)	15.87 (14.5-17.2)	13.91 (12.2-15.6)

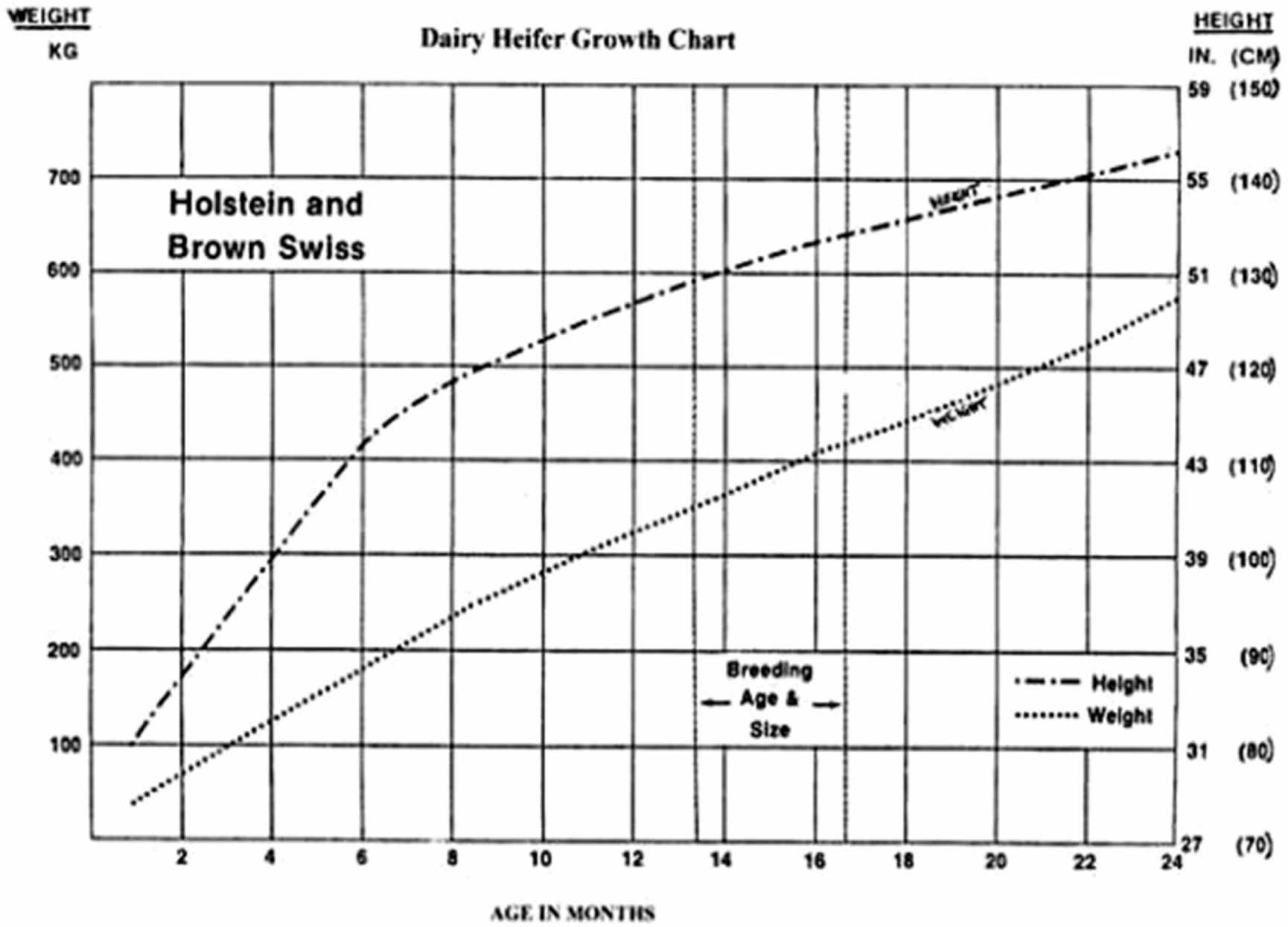
Table 1. Suggested serum values for total cholesterol and nonesterified fatty acids (NEFA) in the periparturient dairy cow.

Serum Metabolite	Early Dry	Close-up Dry	Fresh Cow
Total Cholesterol, mg/dl	> 80	> 75	> 100
NEFA, mEq/L	< 0.325	< 0.40	<= 0.6

Table 29.2 Metabolic profile parameters in cattle. Optimum values

Parameter		SI units
Butyrate	Milkers	Below 1.00 mmol/L
	Dry cows	Below 0.60 mmol/L
Plasma glucose		Over 3.00 mmol/L
NEFA	Milkers	Below 0.70 mmol/L
	Dry cows	Below 0.40 mmol/L
UreaN		1.70–5.00 mmol/L
Albumin		Over 30.00 g/L
Globulin		Under 50.0 g/L
Magnesium		0.80–1.30 mmol/L
Phosphate (inorganic)		1.40–2.50 mmol/L
Copper		9.40–19.00 µmol/L
Thyroxine T4 (iodine)		Over 20.00 nmol/L
GSHPx (selenium)		Over 50 units/g Hb

Calf and heifer growth control and programming


WEIGHT
KG
Dairy Heifer Growth Chart
HEIGHT
IN. (CM)
Holstein and
Brown Swiss
700
600
500
400
300
200
100
59 (150)
55 (140)
51 (130)
47 (120)
43 (110)
39 (100)
35 (90)
31 (80)
27 (70)
HEIGHT
WEIGHT
Breeding
Age &
Size
Height
Weight
2
4
6
8
10
12
14
16
18
20
22
24
AGE IN MONTHS

Thanks for your attention