A black and white cow is shown from the side, grazing in a field of green grass. The cow has a white face with a black blaze, a white neck, and a black body with white patches. It is wearing a yellow ear tag on its left ear and a white collar around its neck. The background is a field of green grass with some dry patches.

**Heidi Rossow, PhD
UC Davis School Of Veterinary Medicine,
VMTRC Tulare, CA**

Interpreting Forage Quality from the Cows' Perspective

Interpretation of chemical nutrient analyses

Plant Nutrient Analyses

Digestibility (Animal)

Physical attributes of forage

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===== SAMPLE NO. ===== DATE ANALYZED =====
TMR PEN 9 X 06/18/13          1079906          06/26/13
=====
MOISTURE      48.39%      DRY MATTER      51.61%

CRUDE PROT    17.92%      CALCIUM          0.87%
SOLUBLE PROT  29.10%      PHOSPHORUS      0.52%
                                     MAGNESIUM       0.28%
                                     POTASSIUM       1.74%
ADF           21.86%      CHLORIDE        0.58%
NDF           33.15%      SULFUR          0.34%
                                     SODIUM          0.39%

ADIP (HD)     1.03%
LIGNIN        3.92%      ZINC             107 PPM
COPPER        18 PPM
FAT           4.44%      IRON             475 PPM
STARCH        19.87%      MANGANESE       93 PPM

ASH           8.96%

                                     CALCULATIONS
IVDMD         80.04%      NFC             38.05
NDFD-30       60.81%
NITRATE-N PPM 134      NEL             0.77 MCAL/LB
                                     TDN             0

COBALT        .56 PPM
  
```

ALL VALUES, EXCEPT MOISTURE, ARE ON A 100% DRY MATTER BASIS.

Nutrients

Water (DM and DMI)

Energy (NE, DE, ME)

Protein (CP, RUP, RDP, MP, SP, NPN)

Fat (Triglycerides, plant lipids)

**Carbohydrates (NDF, ADF, Starch, SC,
Cellulose, Pectins, Hemicellulose,
Lignin, Organic acids, NSC,
NFC, ESC, WSC, Fructans)**

Minerals (Ash)

Vitamins

Nutrients - DM

Dry Matter (%DM)

= Amount of feed w/out H₂O

$100 * \text{Weight of dry feed} / \text{Weight As Fed}$

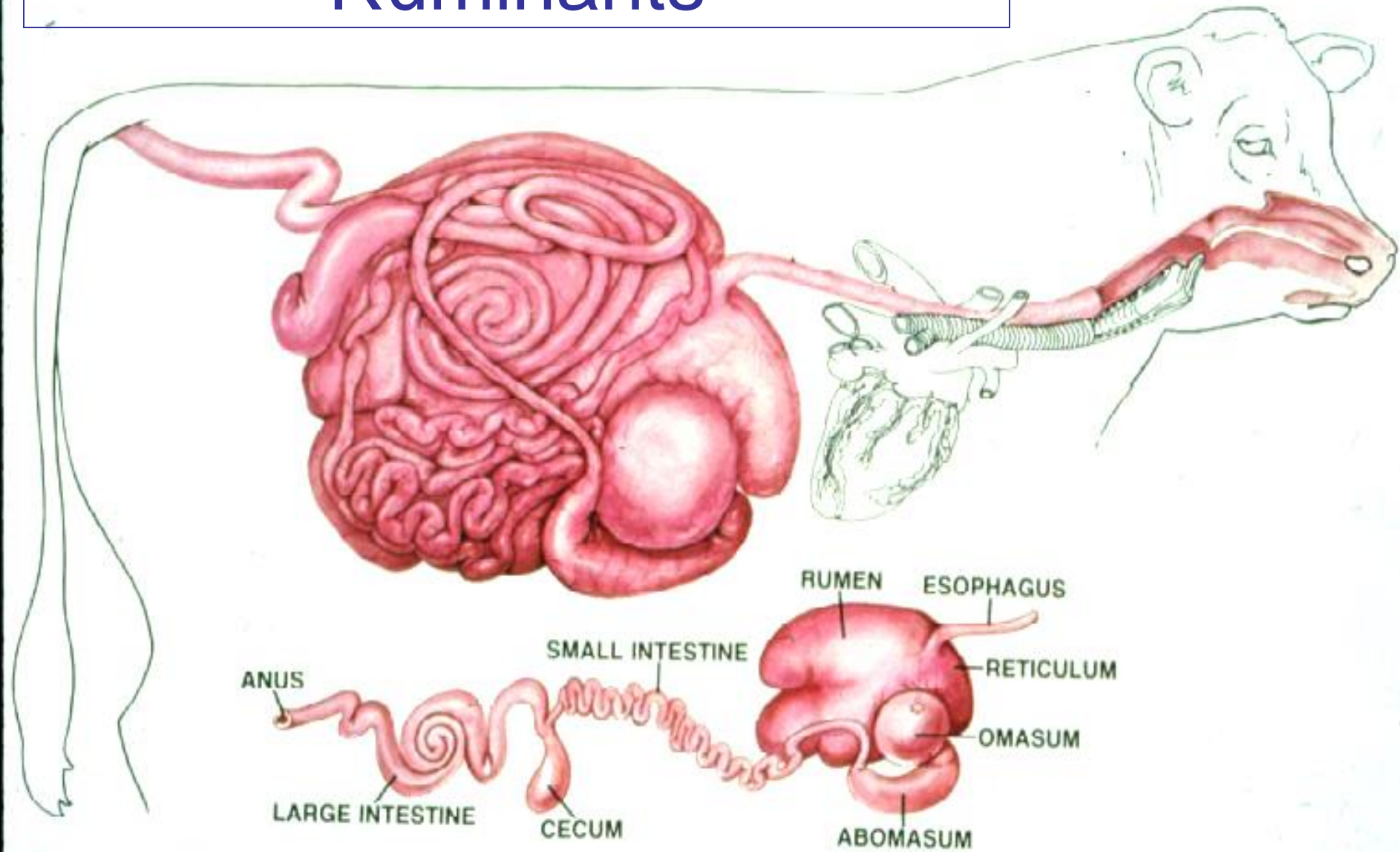
Analysis : Oven or microwave drying

Alfalfa Hay = 85-90%

Corn Silage = 30-45%

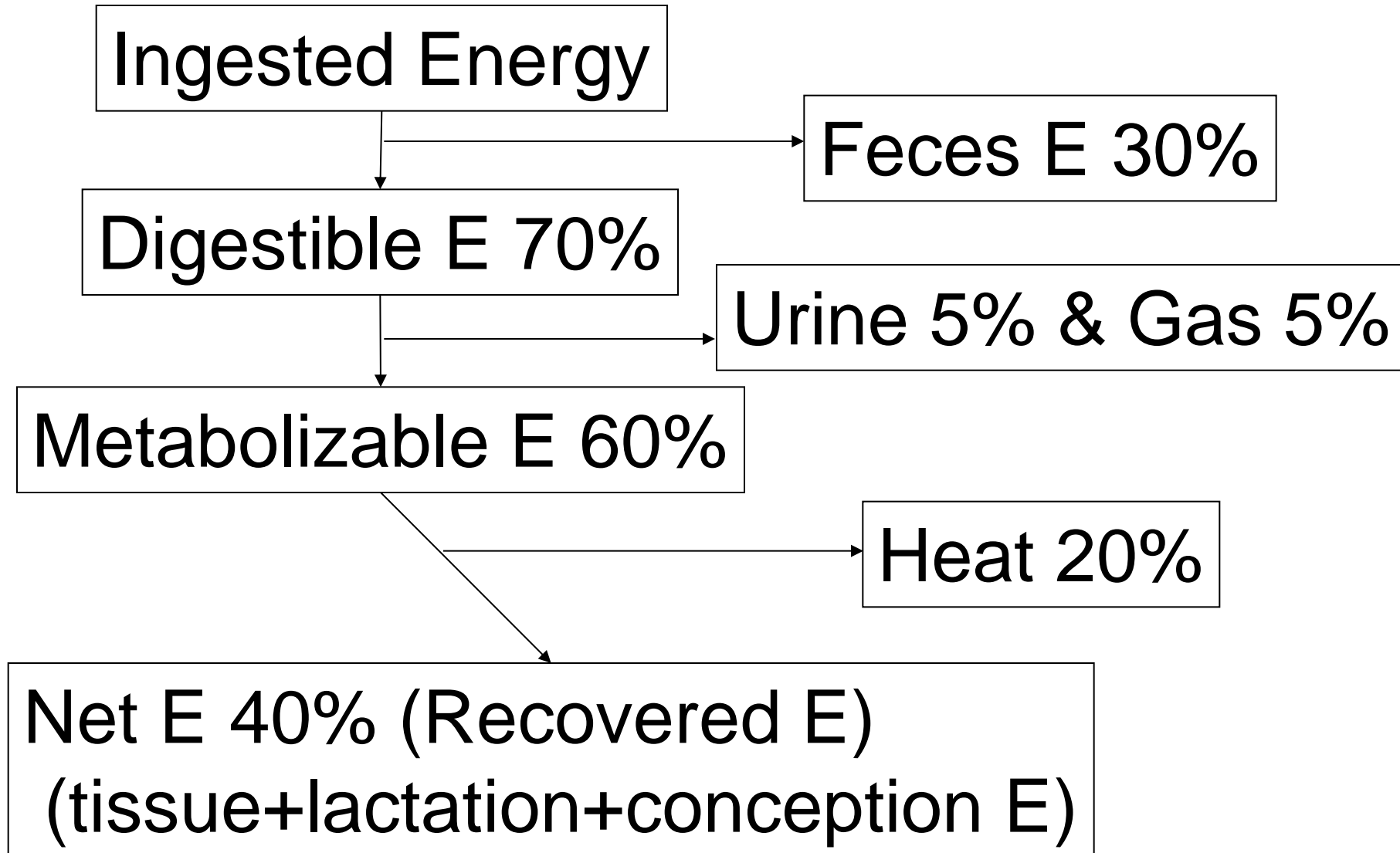
Corn grain = 88-91%

Ruminants

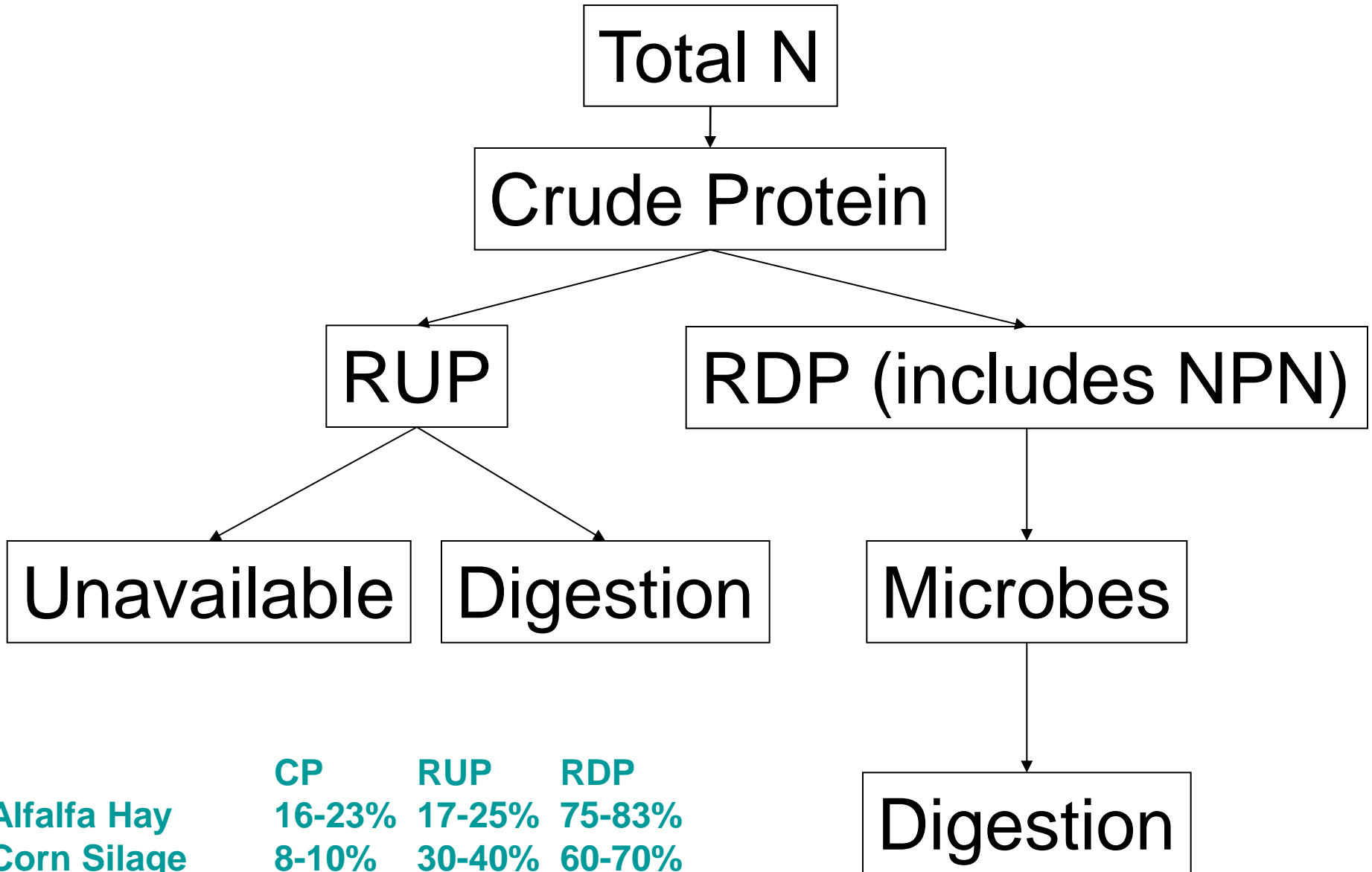


Nutrients - Energy

Alfalfa Hay = 1.27 mcal/kg
Corn Silage = 1.45 mcal/kg
Corn Grain = 2.0 mcal/kg



Nutrients - Protein



	CP	RUP	RDP
Alfalfa Hay	16-23%	17-25%	75-83%
Corn Silage	8-10%	30-40%	60-70%
Corn grain	9-10%	30-50%	50-80%

Nutrients - Fat

**Ether Extract: Fats, oils, waxes,
vitamins ADEK**

FA Analysis: Gas Chromatography

EE

Alfalfa Hay	2-4%
Corn Silage	2.5-3%
Corn Grain	4%

Nutrients - Minerals

**Ash Analysis: Total mineral content
muffle oven, ICPMS digestion**

Macro : Ca, P, Na, Cl, K, Mg, S

Micro : Co, Cu, I, Fe, Mn, Mb, Se, Zn, Cr

Analysis: Boiled in acid, AAS, ICPMS

	Ash	Ca	P	K
Alfalfa Hay%	10	1.5	0.3	1.7
Corn Silage%	4-5	0.28	0.25	1.0
Corn Grain%	1.5	0.04	0.3	0.4

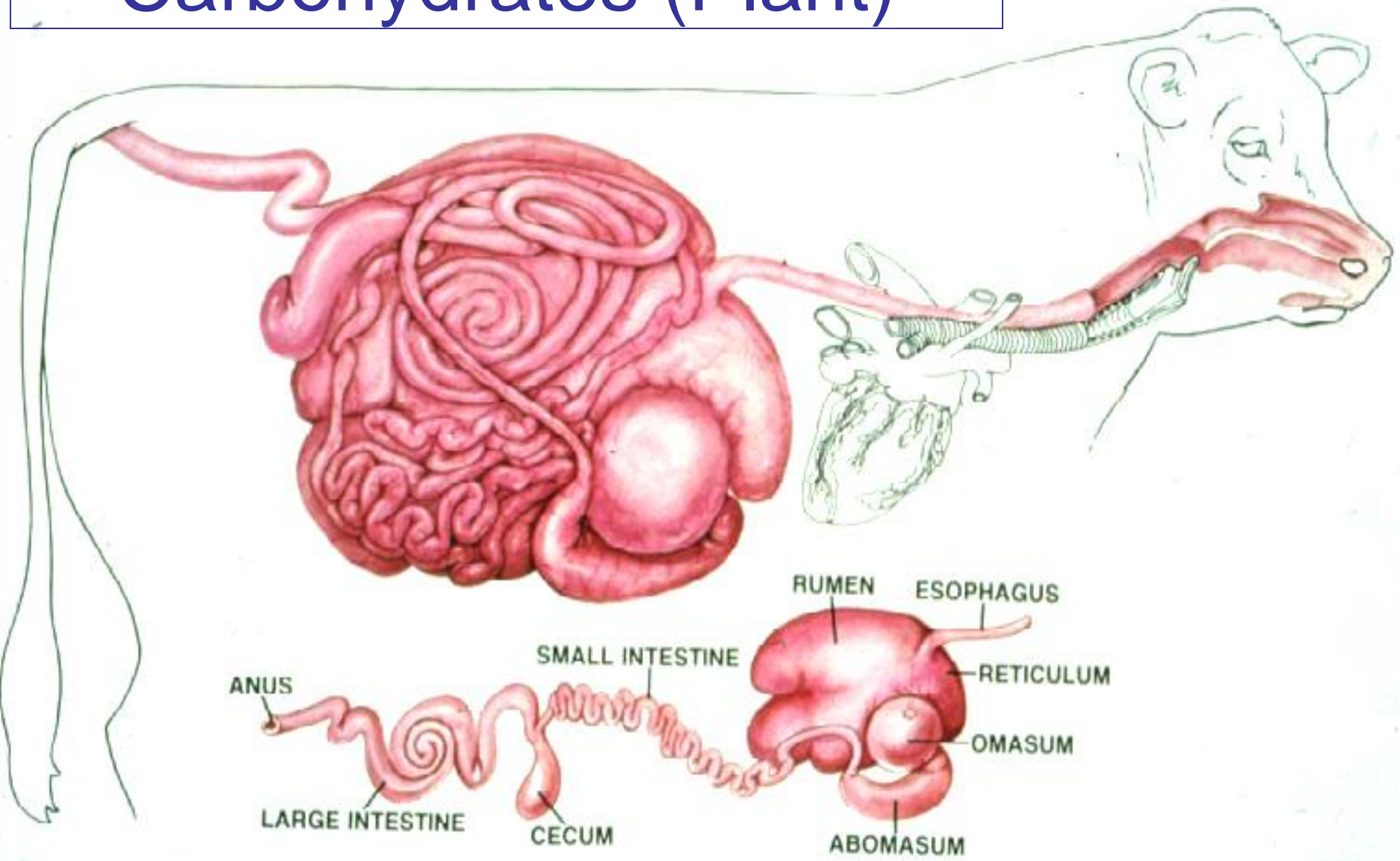
Interpretation of chemical nutrient analyses

Plant Nutrient Analyses

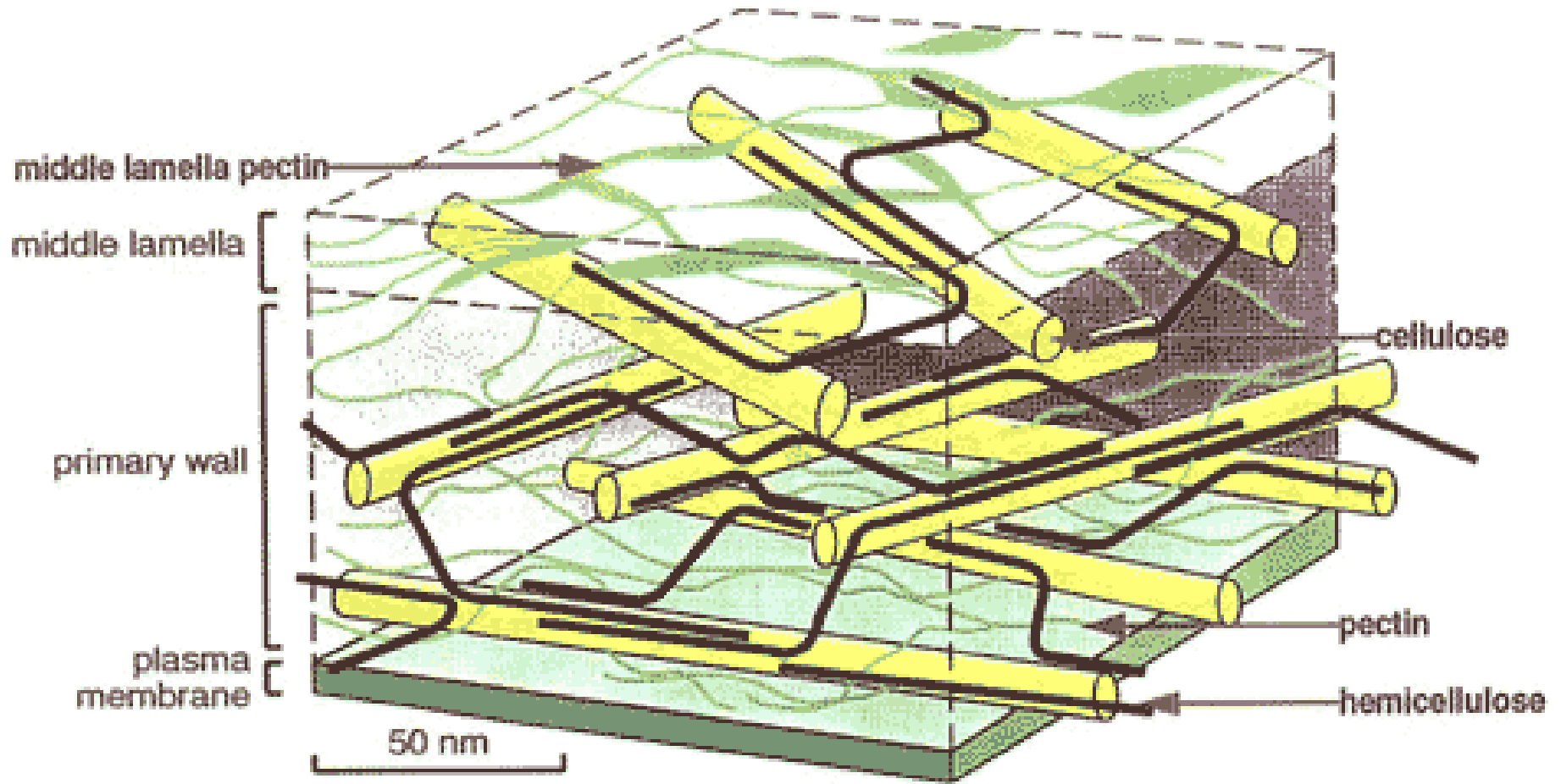
Digestibility (Animal)

Physical attributes of forage

Carbohydrates (Plant)



Nutrients - Carbohydrates



Nutrients - Carbohydrates

NDF = Neutral detergent fiber

**Cell Wall (NDF Residue) =
cellulose, hemicellulose, lignin**

**Cell Contents (NDF Soluble) = protein, NPN, lipid,
starch, sugars, fructans, organic acids**

	NDF	NDICP (%DM)
Alfalfa Hay	35-50%	2-3%
Corn Silage	45-70%	1.3%
Corn Grain	9-10%	0.7%

Nutrients - Carbohydrates

ADF = Acid detergent fiber

ADF Residue = Cellulose, Lignin

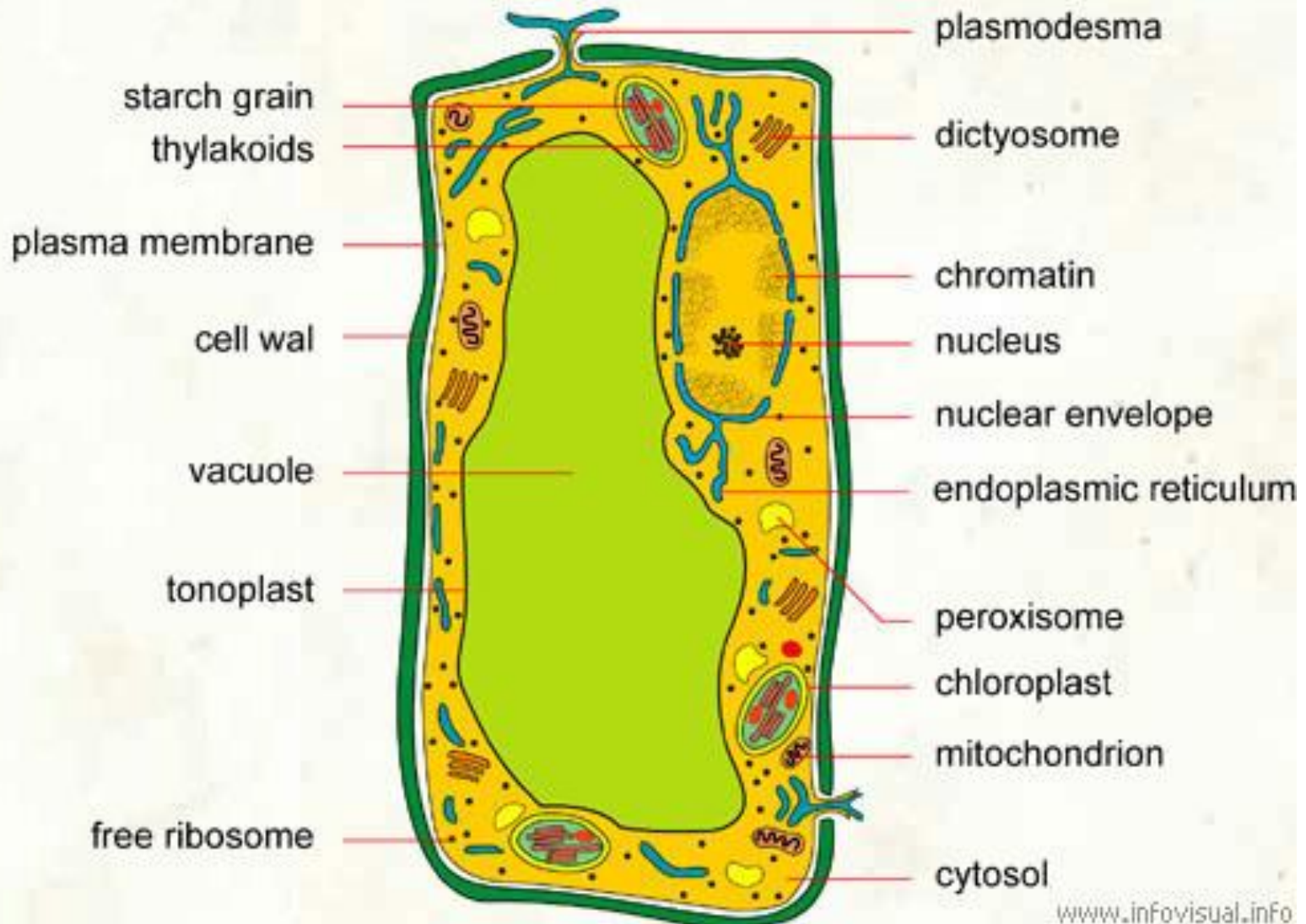
ADF Soluble = everything else

**ADFIN Acid Detergent Insoluble N =
Bound N (unavailable to cow)**

	ADF	ADICP	Lignin
Alfalfa Hay	25-40%	1.5%	6-7%
Corn Silage	28-35%	0.9%	3.4%
Corn Grain	3.5%	0.3%	0.9%

Nutrients - Carbohydrates

PLANT CELL



Nutrients - Carbohydrates

**NSC = Non structural carbohydrate (enzymatic)
(starch, fructans, sugars)**

**NFC = Non fiber carbohydrate (by difference)
(starch, sugars, pectins)**

NFC = 100-(NDF+CP+Fat+Ash)

Starch = amylose, amylopectin

	NSC	NFC	Starch	Sugar	Pectin
Alfalfa Hay %	12.5	22.0	24.5	20	33
Corn Silage %	34.7	41.0	71.3	0	0
Corn Grain %	68.7	67.5	80.0	20.9	0



Sample # 3	HIS SILAGE-NORTH		
Lab # 58668	Sampled on 1/6/2012	Received on 1/6/2012	
Feeder	Charge \$42.00		

Moisture 62.60%	Dry Matter 37.40%	90% DM Basis	As Received Basis
Analyte Description	Dry Matter Basis		
Ammonium-N %DM	0.31%	0.28%	0.12%

Calculations

Comments

Yeast Count: 500,000 cfu/gr (Medium)

Mold Count: 50,000 cfu/gr (Very Low)

Lactic Acid 1.22 % DM
 Acetic Acid 1.64 % DM
 Propionic Acid <0.01 % DM
 Butyric Acid 0.03 % DM
 Total VFA 2.89 % DM
 Lactic Acid/Total VFA 42.21 %
 Ammonium-N 0.26 Crude Protein Equivalent
 Ammonium-N <0.01 % of Crude Protein

MOLD ID - YEAST, Penicillium (50%), Aspergillus fumigatus (10%) and Mucor (40%).

Aspergillus fumigatus IS PRESENT AT THIS TIME!

Nutrients – (Corn Silage)

Yeast < 100,000 cfu

pH < 5

Mold < 600,000 cfu

Mold Types

Total VFA = 10-14%

Lactic = 3-7%, > 60% of total

Acetic = 1-3.5%

Lactic / acetic > 3:1

Propionic 0-1%

Butyric < 0.1%

Ethanol = 1-3%

Ammonia = 5-7%

Temp = Depends on stage, Ambient

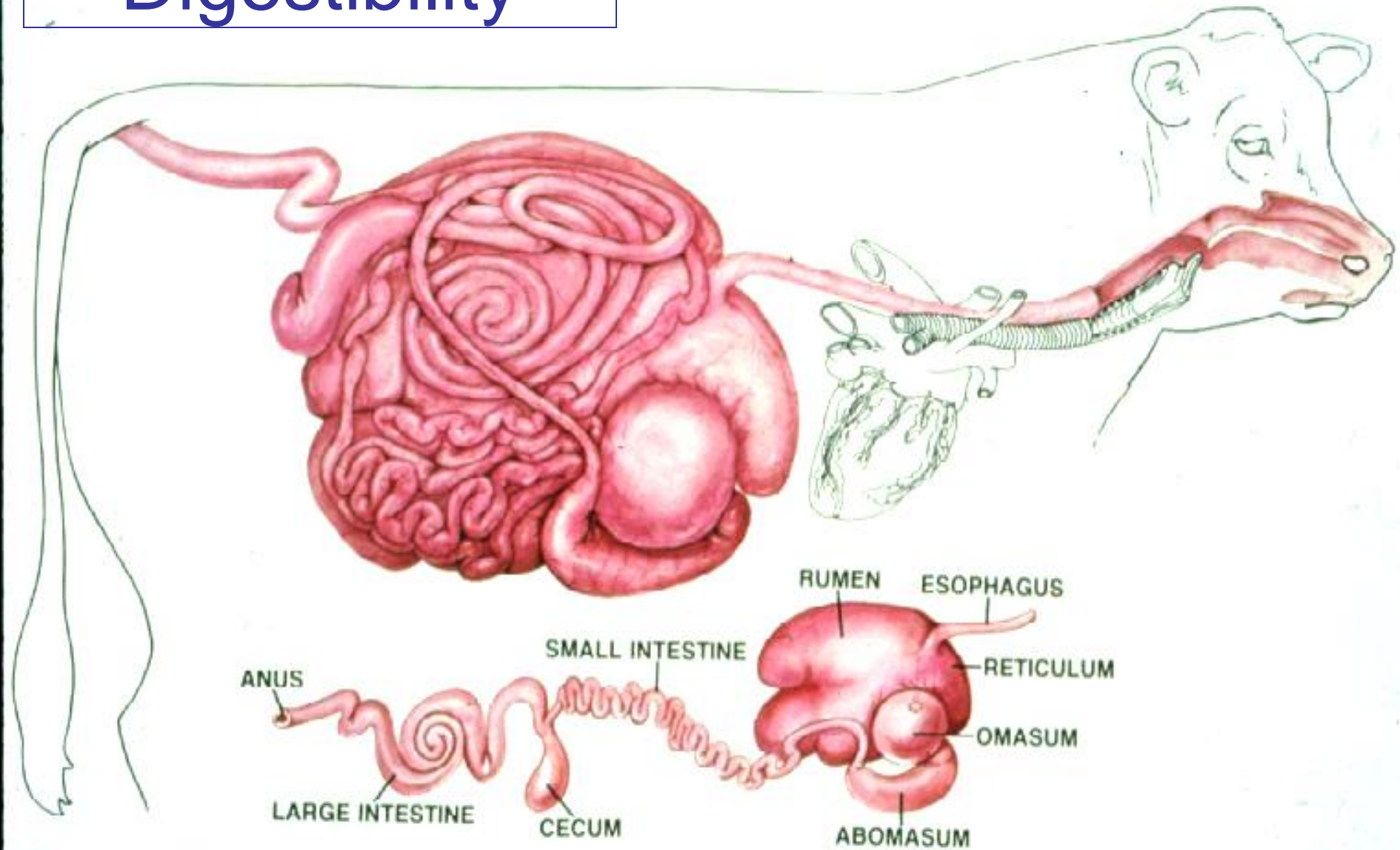
Interpretation of chemical nutrient analyses

Plant Nutrient Analyses

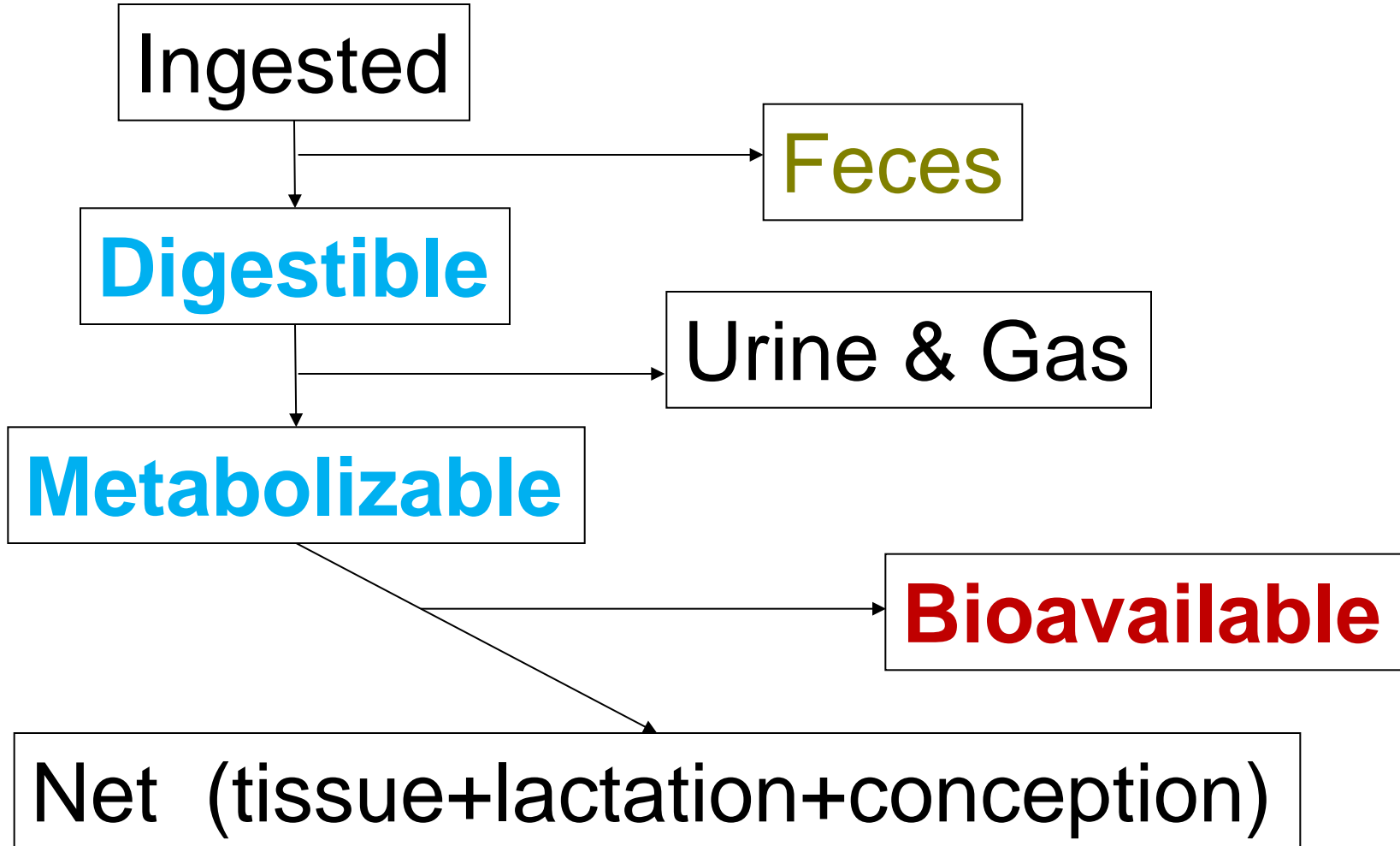
Digestibility (Animal)

Physical attributes of forage

Digestibility



Animal Response



TDN

**Related to Proximate Analysis,
represents energy content of feeds**

**TDN = digestible NFE + digestible CF +
digestible protein + digestible EE*2.25**

OR

TDN = DE/0.044

TDN

Alfalfa Hay

55-60%

Corn Silage

65%

Corn Grain

85-92%

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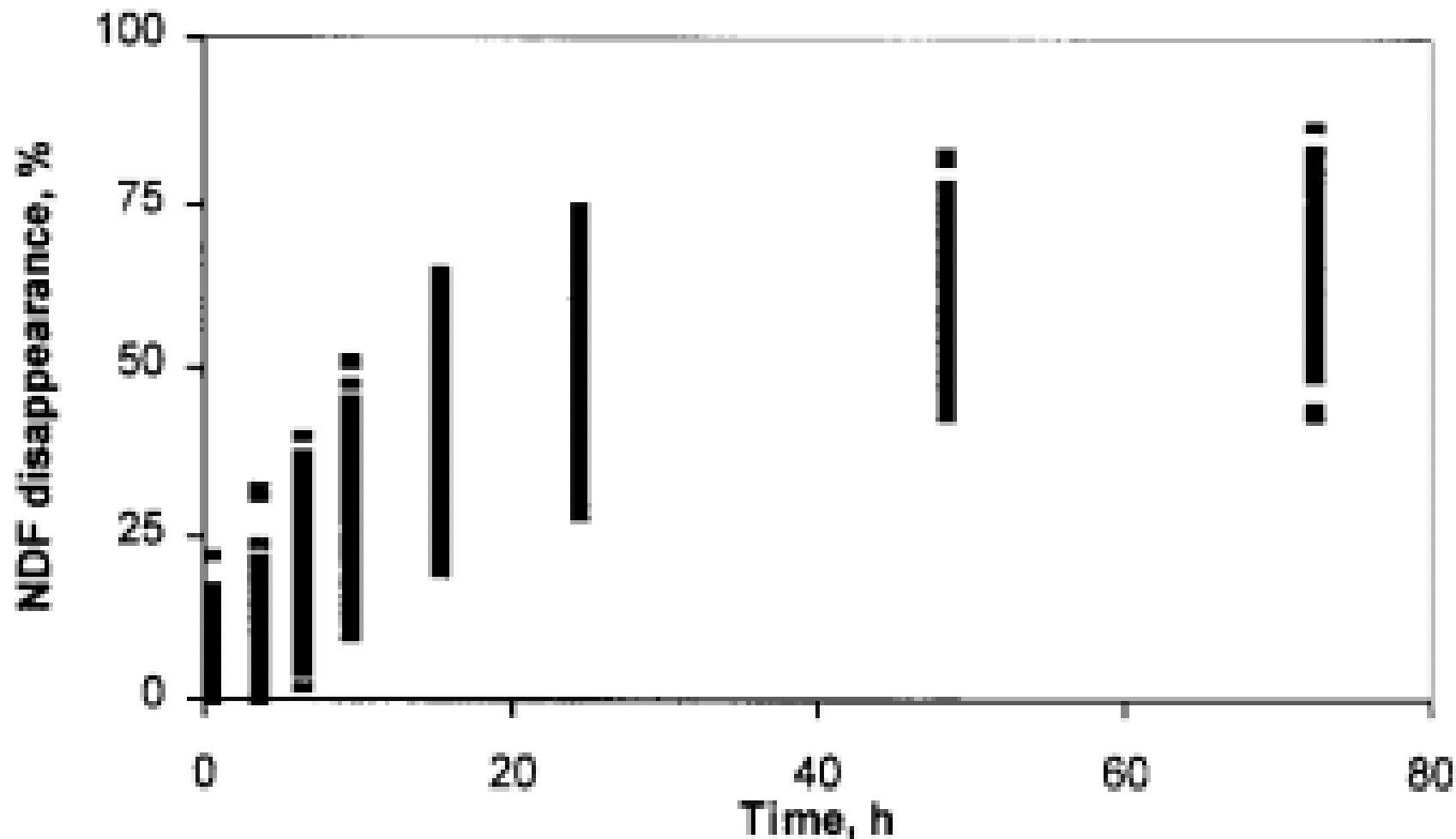


Figure 1. Plots of DM, N, and NDF in situ disappearance curves (each plot contains the curves of a total number of 87 forages; see text for details).

Alfalfa Digestibility



Stage	%Digestibility
Pre-bud	66.8
Bud	65
Early Bloom	63.1
Mid-Bloom	61.3
Full-Bloom	59.4
Late-Bloom	57.5
Mature	55.8

GROWTH

Stage	%Leaves	% CP	%ADF	%NDF	RFV
Bud	>40	>18	<30	<40	>140
Early Bloom	30-40	16-18	30-35	40-45	124-140
Mid-Bloom	20-30	13-16	35-40	45-50	100
Full-Bloom	<20	<12	>40	>50	<100

Interpretation of chemical nutrient analyses

Plant Nutrient Analyses

Digestibility (Animal)

Physical attributes of forage

Physical Attributes

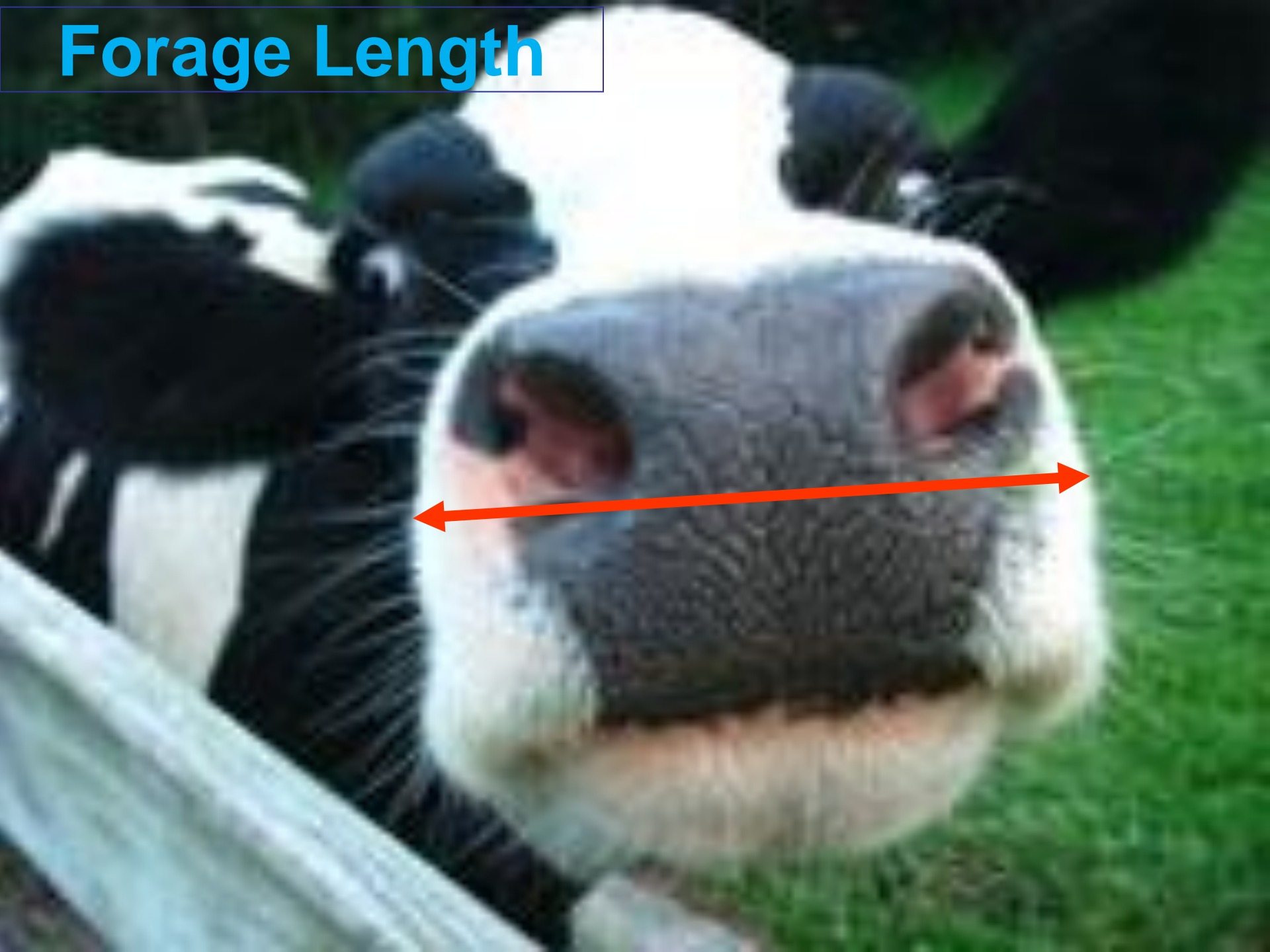
**Forage length – Sorting (Silage packing)
(Shear Force)**

Particle Size – Ruminantion, Rumen pH

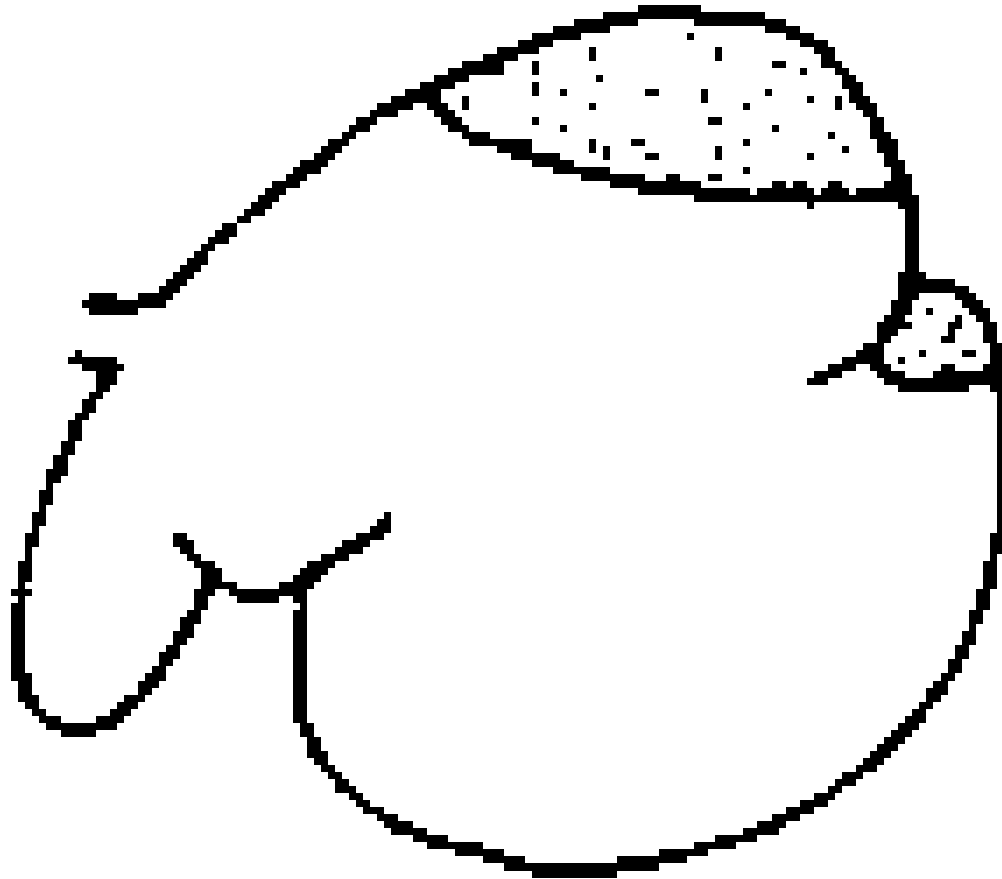
Processing / Processing score – Digestion

**Fecal Starch, Fecal Sorting, Fecal Scoring
- Digestion**

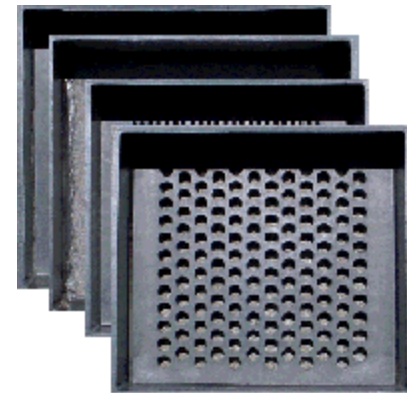
Forage Length



Particle Size



Particle Size



6. Particle Size Recommendations for Silages, TMR and Grains

Sieve	Corn Silage	Hay Silage	TMR
Upper screen (>0.75")	3 (not sole forage) to 8 (sole forage) %	10 (sealed silos) to 20 (bunker silos) %	2-8 %
Second screen (0.75-0.31")	45-65 %	45-75 %	30-50 %
Third screen (0.31-0.07")	30-40%	20-30%	30-50%
Bottom pan (<0.07")	< 5%	< 5%	< 20%

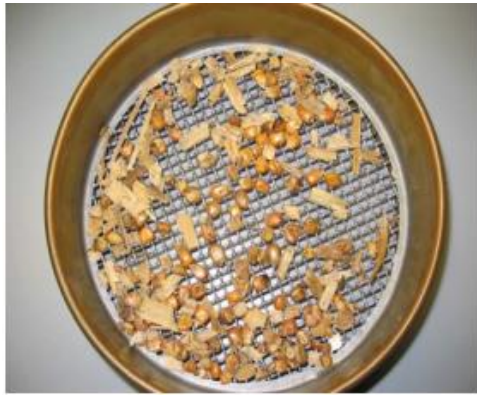
Corn Processing

Processing:
Whole
Cracked
Steam Flaked
Dry Rolled
Ground



Shifts site of digestion and Starch digestibility
Rumen (DR 34% SF Thin 45% SF Thick 27%)
Intestines (DR 44% SF Thin 50% SF Thick 58%)

Corn Silage Processing Score



Coarse Fraction $> 4.75\text{mm}$ (Starch)
Fine Fraction $< 1.18\text{mm}$ (NDF)

<u>% Starch passing coarse screen</u>	<u>Ranking</u>
Greater than 70%	Optimum
50% to 70%	Average
Less than 50%	Inadequate

Fecal Starch

Enzymatic lab analyses (\$17- \$20)

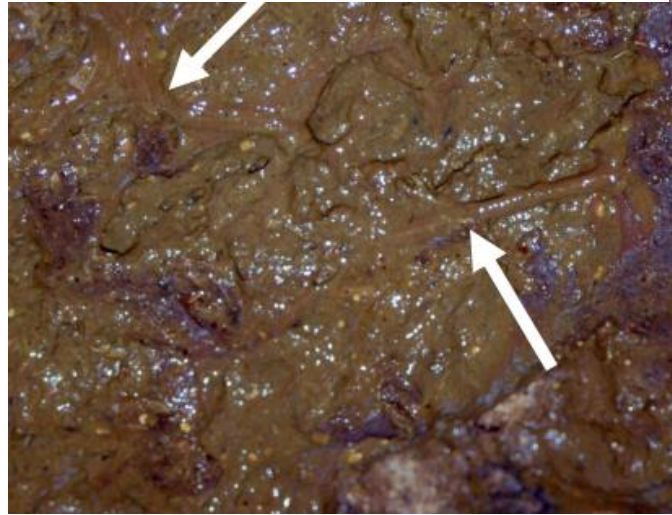
Fecal Starch < 4.5%

1% = 0.67 lbs Milk

Corn in Feces, fecal starch >10%



Fecal Sorting and Scoring



Fecal Sorting



Thanks...

