

# Module 2 – Care and Welfare of domestic animals

## Fundamental components of food

### Part 1: Nutrients and energy

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(with acknowledgement to Dr. Ian Bland)



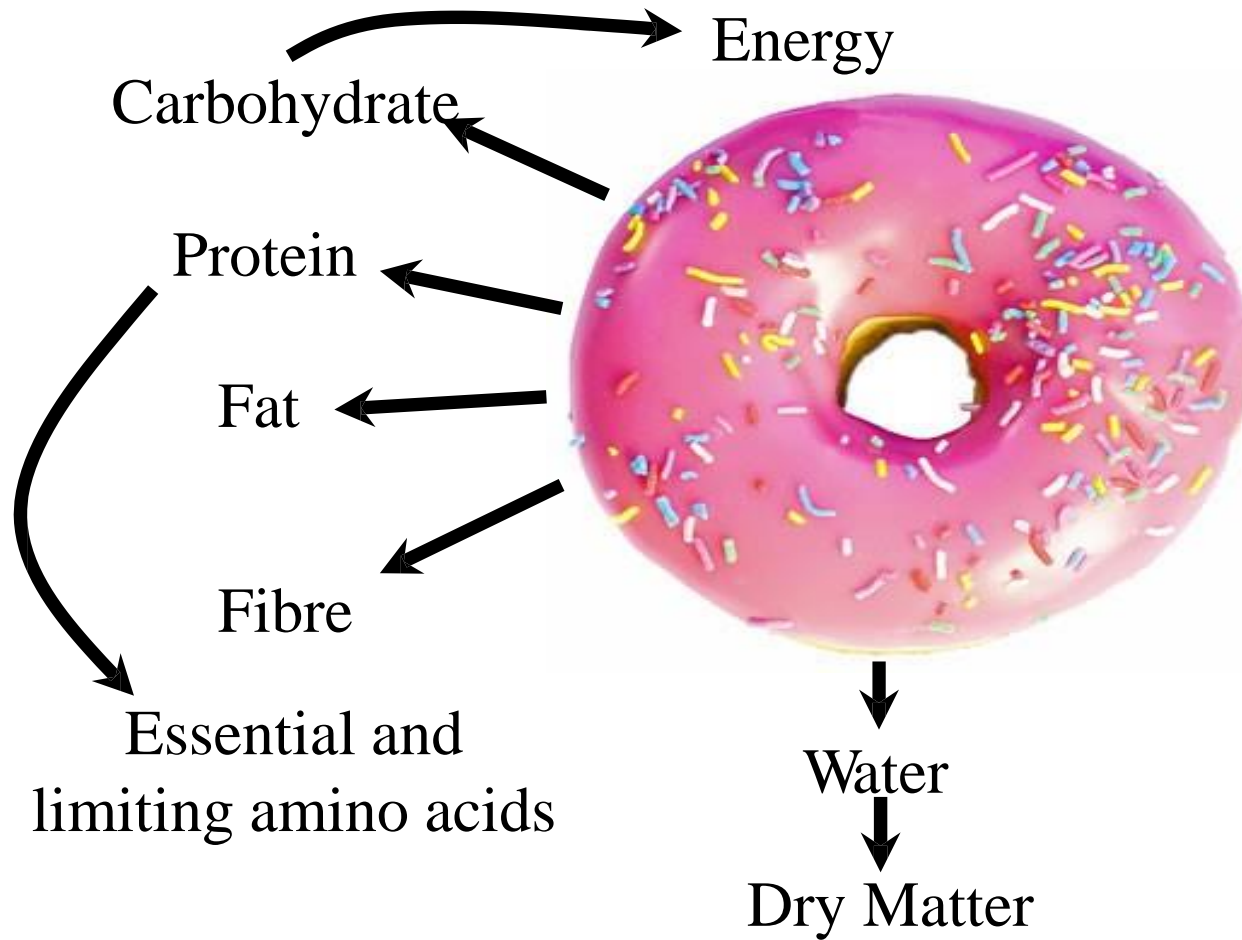
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# Intended Learning Outcomes

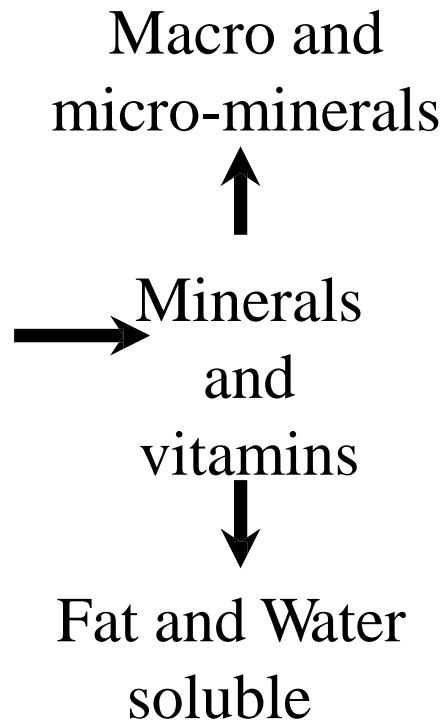
At the end of this week of study you should be able to:

- Describe the constituents of animal feeds, in order to explain their role in body processes and their importance in the diets of animals.
- Explain the methods and units used to measure feed constituents and dietary availability, in order to understand feed labelling and feed quality when recommending or formulating diets.

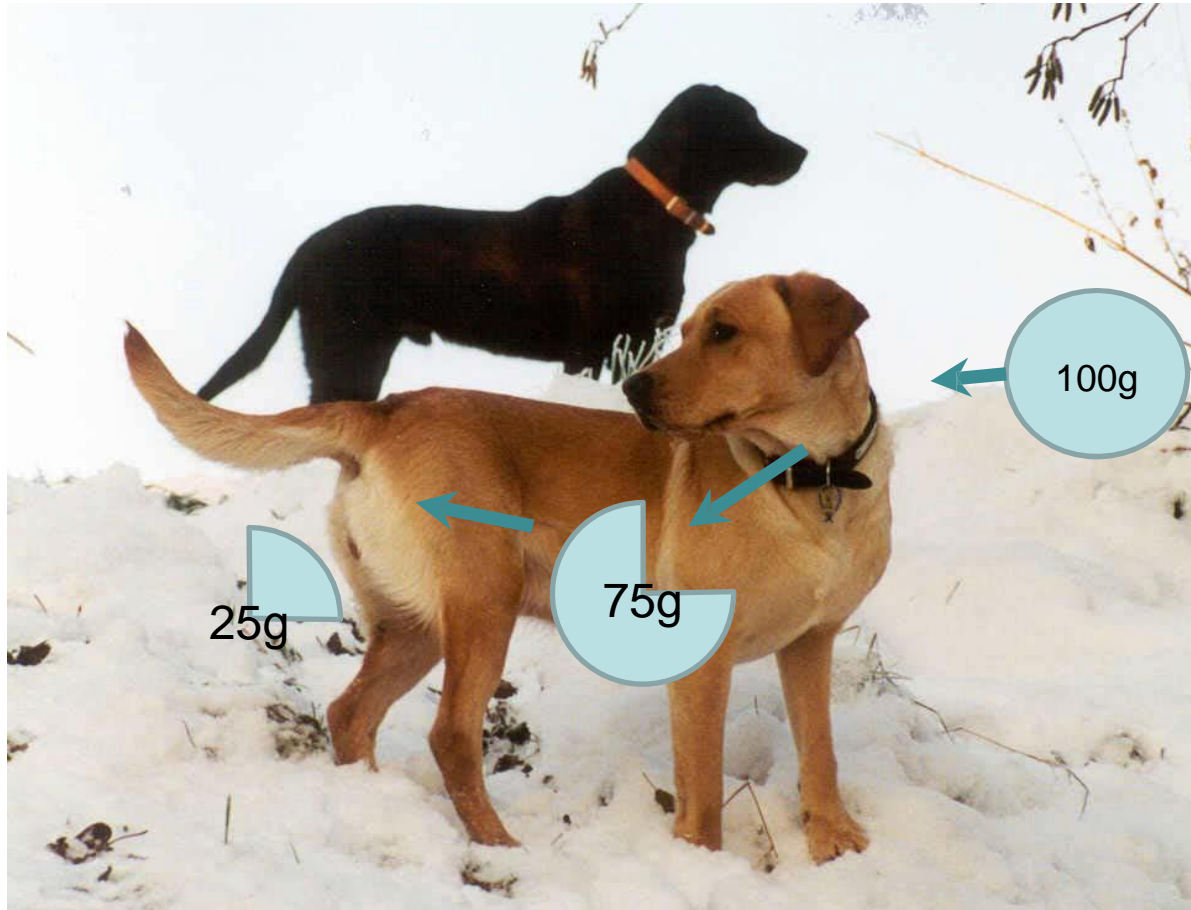
# Macronutrients

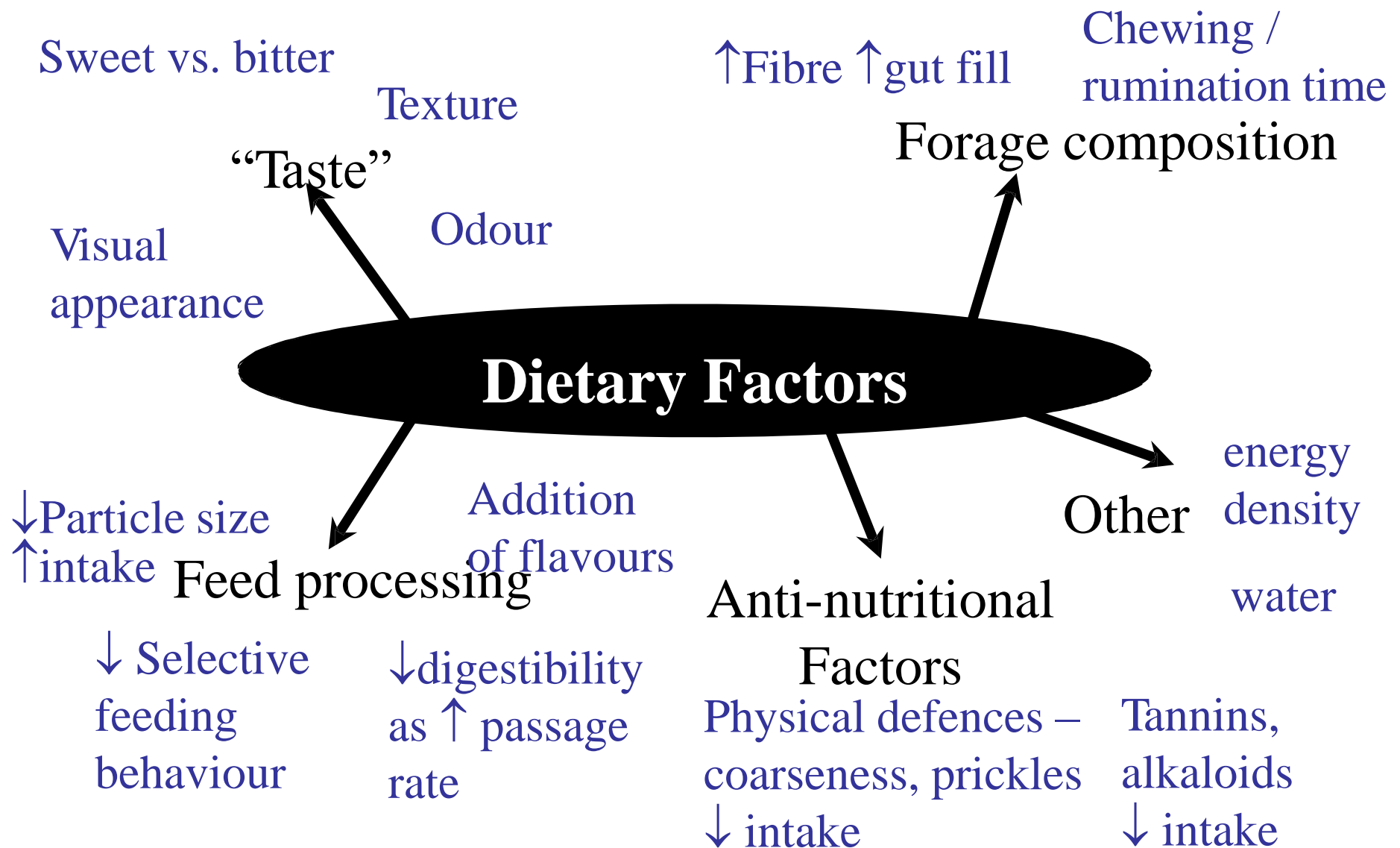


# Micronutrients



# Digestibility





# Energy

- Baseline feed requirement in animal nutrition
  - Definition of “life”
  - Traditionally measured as “heat”
- **calorie** - amount of heat required to raise the temperature of 1g H<sub>2</sub>O 1°C.

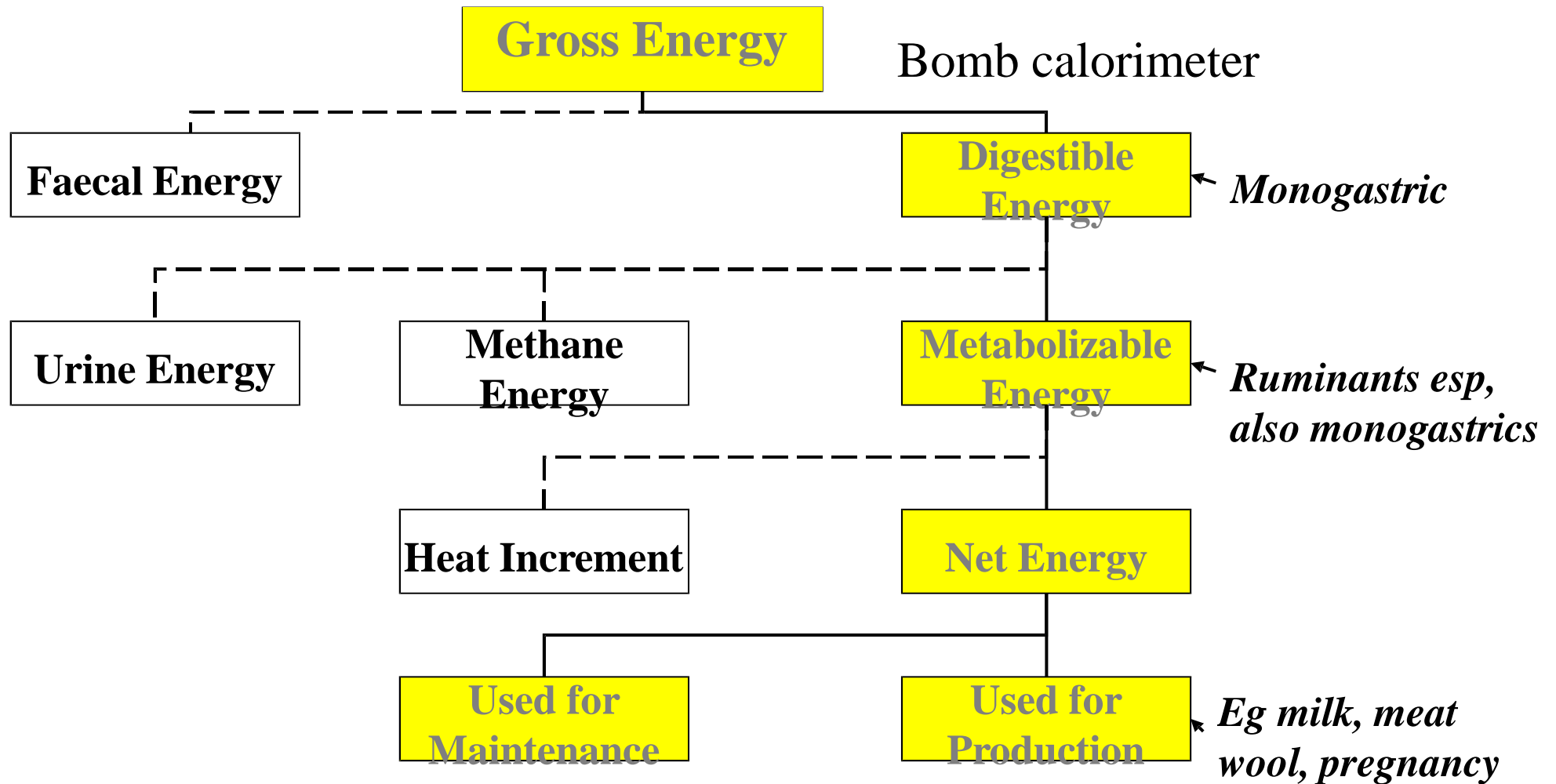


# Energy

- 1 **Calorie** = 1000 **calories** = 1kcal.
- 1 calorie = 4.184 Joules
  - kilojoule (KJ), megajoule (MJ)



# Energy partitioning in animals



<b>Feed component</b>	<b>Energy (MJ/kg)</b>
<b>Protein</b>	22.3
<b>Fat</b>	39.0
<b>Fibre</b>	17.0
<b>Carbohydrate</b>	16.8

# Module 2 – Care and Welfare of domestic animals

## Fundamental components of food

### Part 2: Proteins and lipids

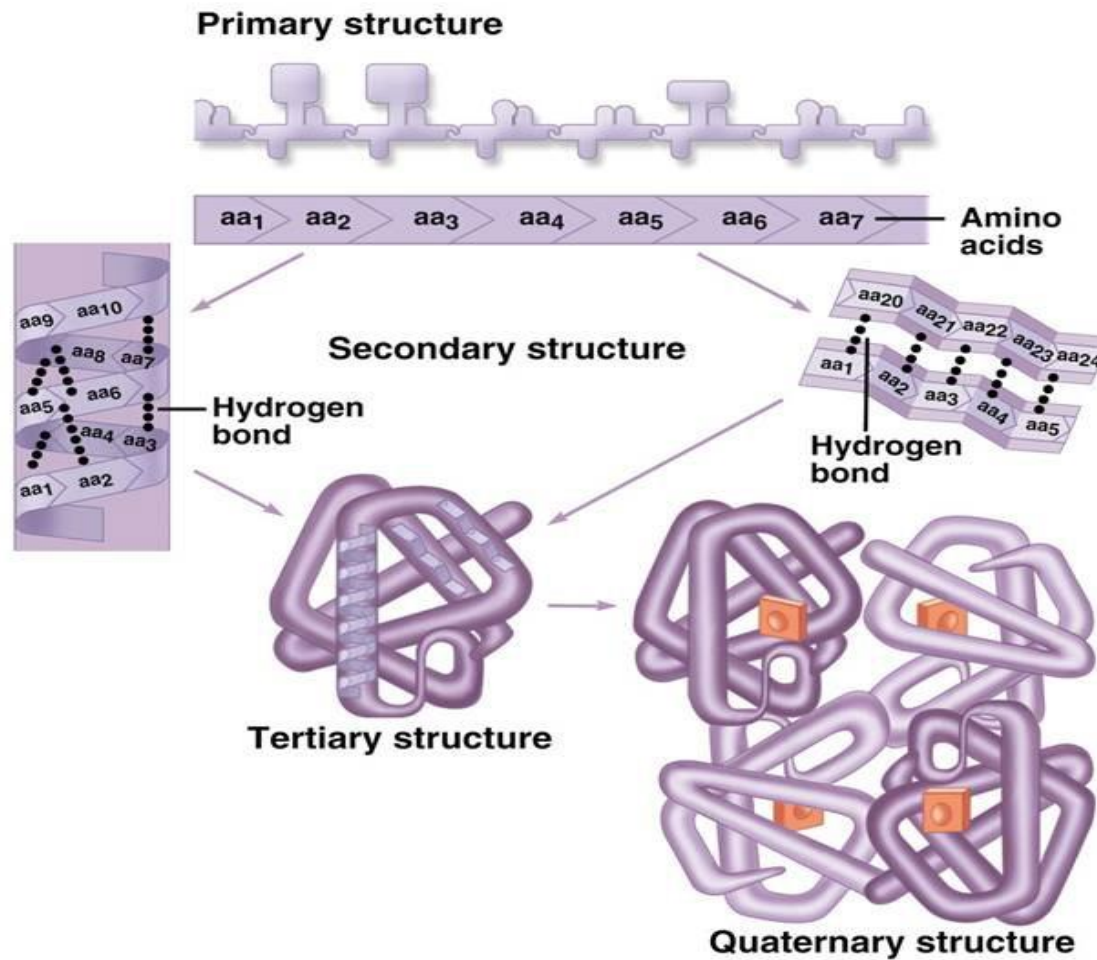
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# Protein



# Crude Protein



```
graph TD; CP[Crude Protein] --> BV[Biological Value]; CP --> IP[Ideal Protein]; BV --> LA[Limiting amino acids]; BV --> EA[Essential amino acids]; IP --> LA; IP --> EA;
```

## Biological Value

Amount of  
absorbed protein  
that is retained by  
animal

## Ideal Protein

How the protein  
maps to animal's  
need

## Limiting amino acids

aa found in the lowest quantity  
in a feedstuff relative to  
requirements, thus limiting  
protein construction

## Essential amino acids

aa that cannot be made by  
the body in sufficient  
quantities. Must be in diet.  
Conditional essentiality

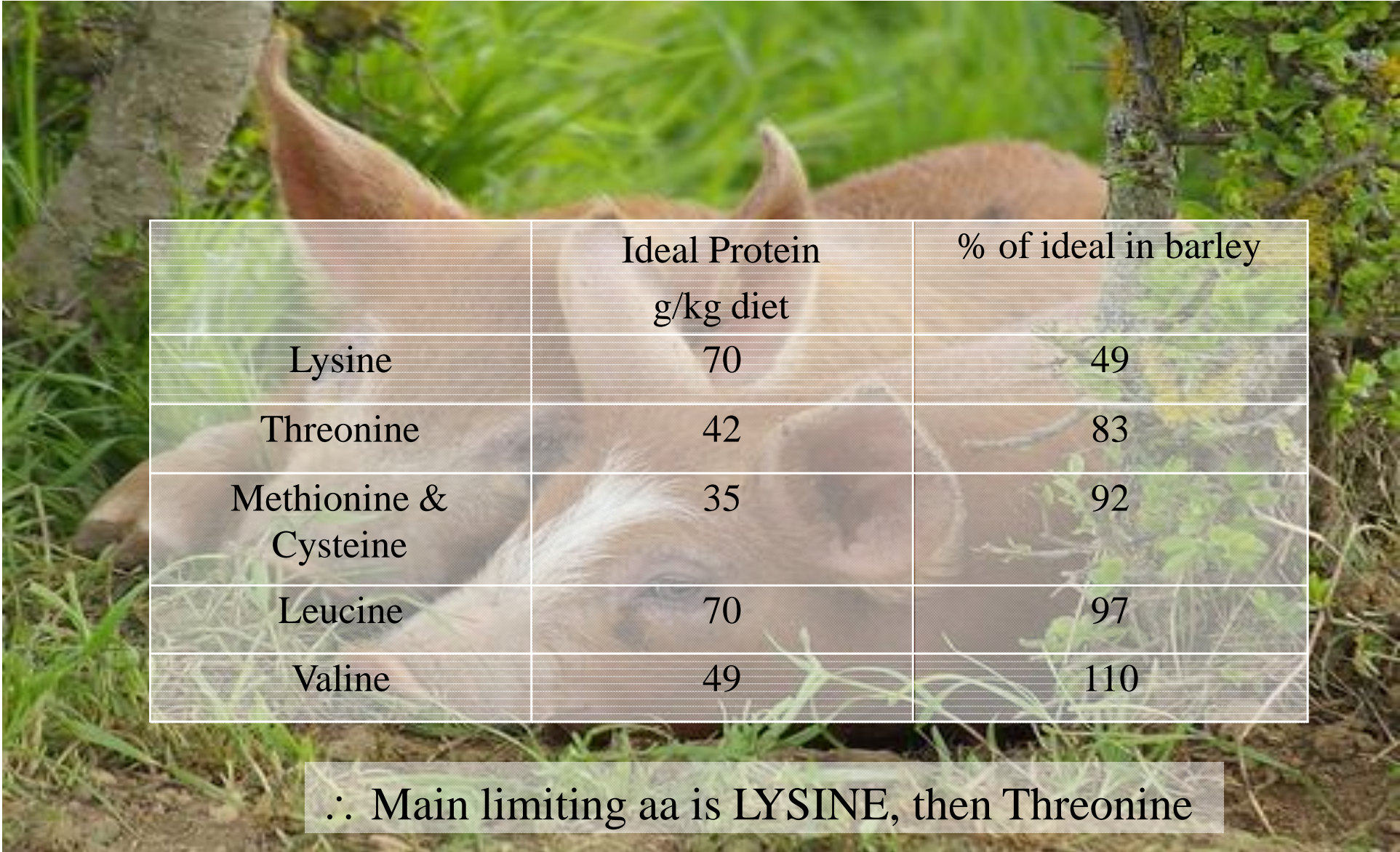
# Essential amino acids

- arginine
- histidine
- isoleucine
- lysine
- leucine
- methionine
- phenylalanine
- threonine
- tryptophan
- valine
- taurine





# Limiting amino acids

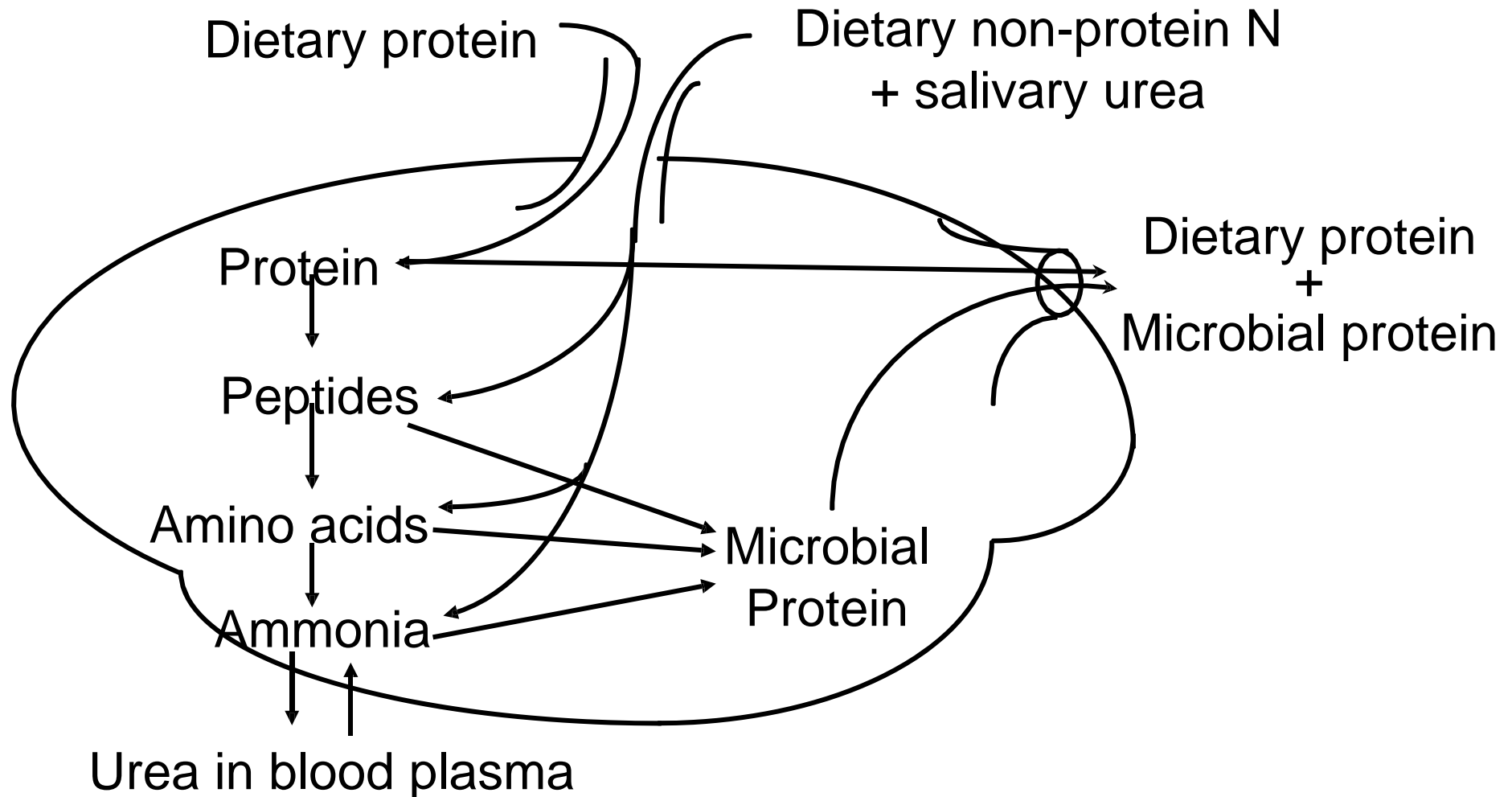


	Ideal Protein g/kg diet	% of ideal in barley
Lysine	70	49
Threonine	42	83
Methionine & Cysteine	35	92
Leucine	70	97
Valine	49	110

∴ Main limiting aa is LYSINE, then Threonine



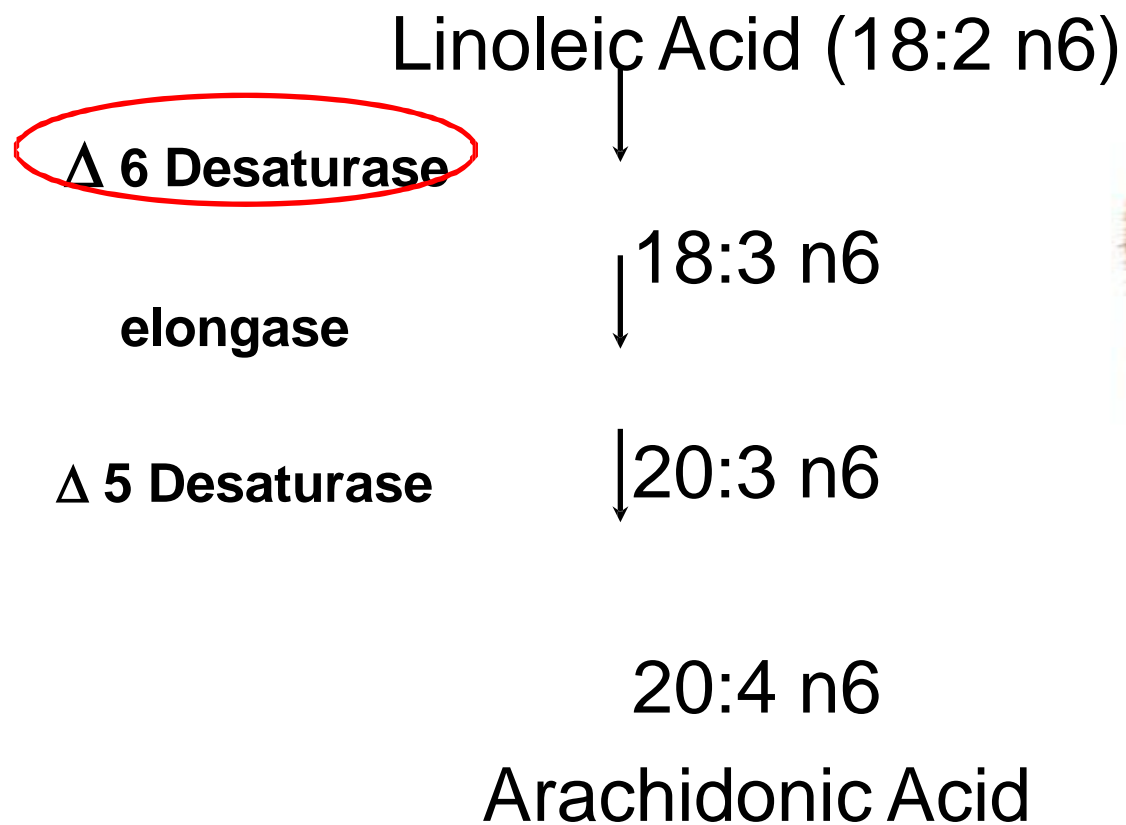
# Protein metabolism in the rumen



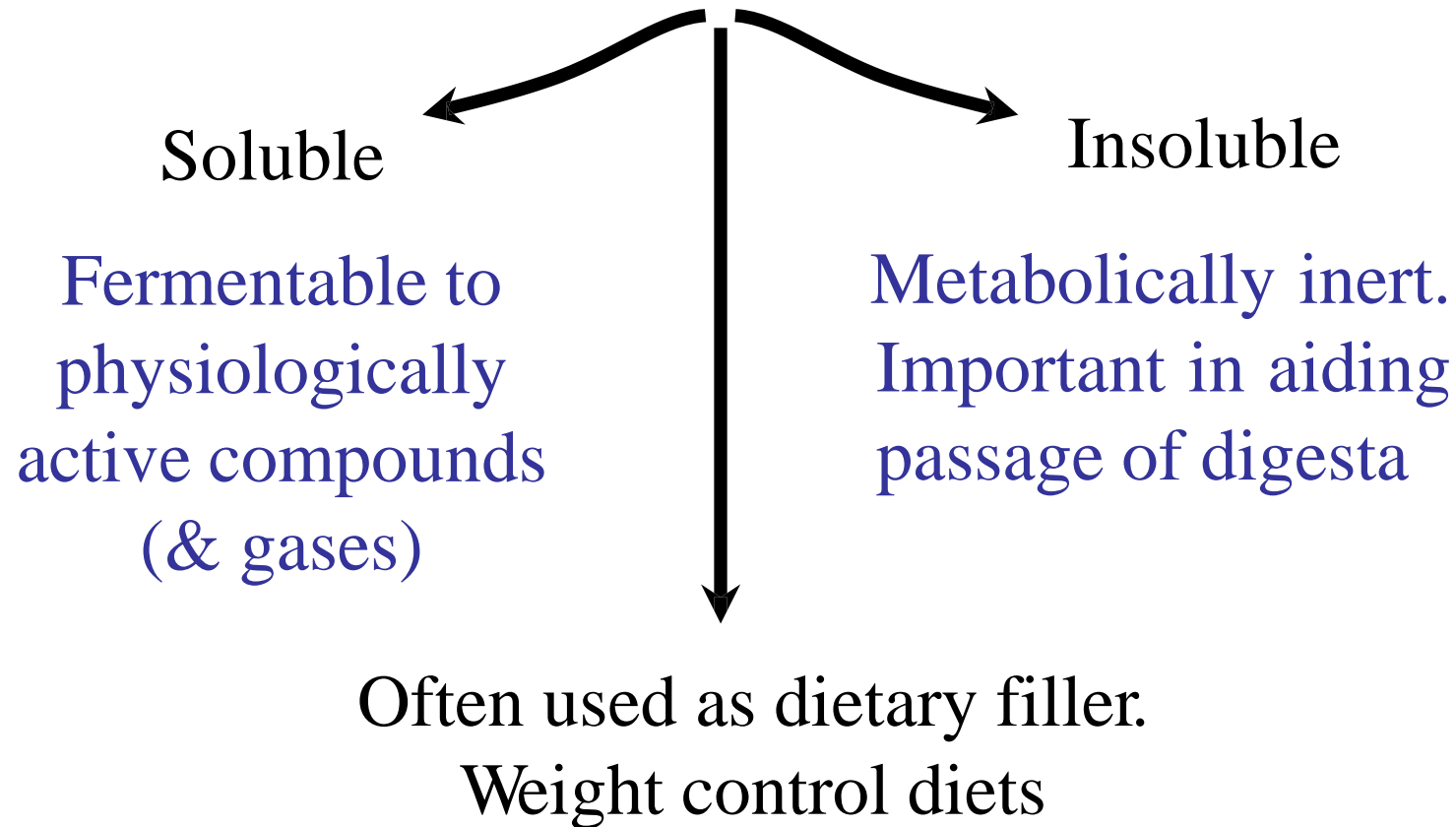
# Lipids

- Lipids – fats (animal based) and oils (plant based)
  - Simple lipids e.g. triglycerides
  - Compound lipids e.g. phospholipids
  - Others: waxes, steroids etc
- Energy storage mechanism
- Essential Fatty Acids

# Essential Fatty Acids



# Fibre



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### Part 3: Vitamins and minerals

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# Vitamins

## Fat Soluble

Absorbed with fat  
in small intestine  
Stored in liver and  
adipose tissues

Toxicities

## Water Soluble

Absorbed in small intestine

Filtered by kidneys  
and excreted

Daily need – no toxicities

# Vitamins

## Fat Soluble

	Name
A	Retinol
D <sub>2</sub>	Ergocalciferol
D <sub>3</sub>	Cholecalciferol
E	Tocopherol
K	Phylloquinone

## Water Soluble

	Name
B complex	Thiamin
B <sub>1</sub>	
B <sub>2</sub>	Riboflavin
B <sub>3</sub>	Nicotinamide (niacin)
B <sub>6</sub>	Pyridoxine
	Pantothenic acid
	Biotin
	Folacin (folic acid)
	Choline
B <sub>12</sub>	Cyanocobalamin
C	Ascorbic acid



# Minerals

## Macro-minerals

Sodium, potassium,  
magnesium, calcium,  
phosphorus, sulfur,  
chloride

Present in body  
tissues at  
concentrations  $>50$   
mg/kg (50 ppm)

## Micro-minerals

Chromium, manganese,  
iron, cobalt, molybdenum,  
copper, zinc, fluoride,  
iodine, selenium, silicon,  
tin, arsenic, nickel...

Present in body  
tissues at  
concentrations  $<50$   
mg/kg (50 ppm)

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## Fundamental components of food

### Part 4: Measuring feed components and quality

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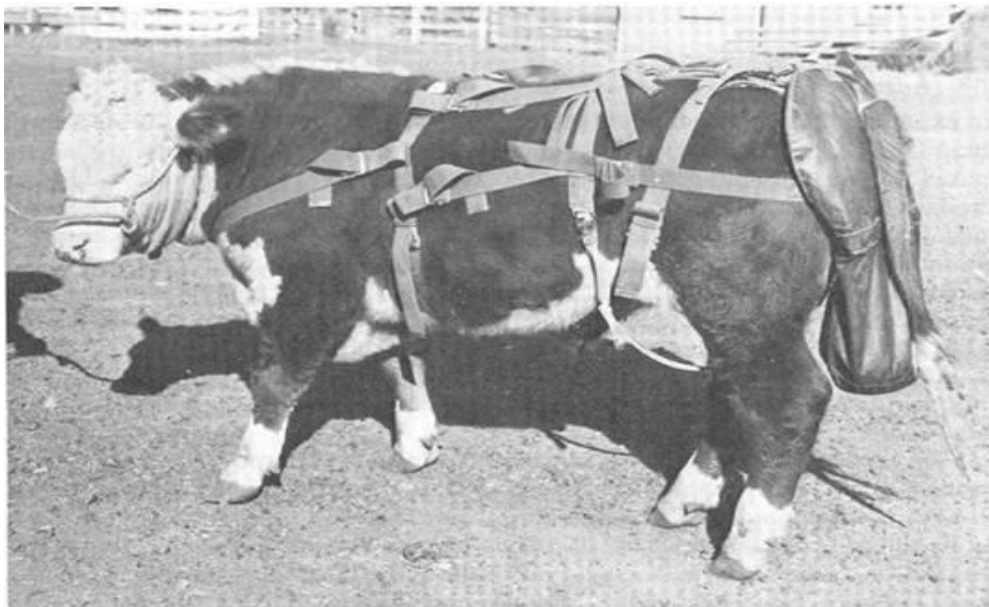
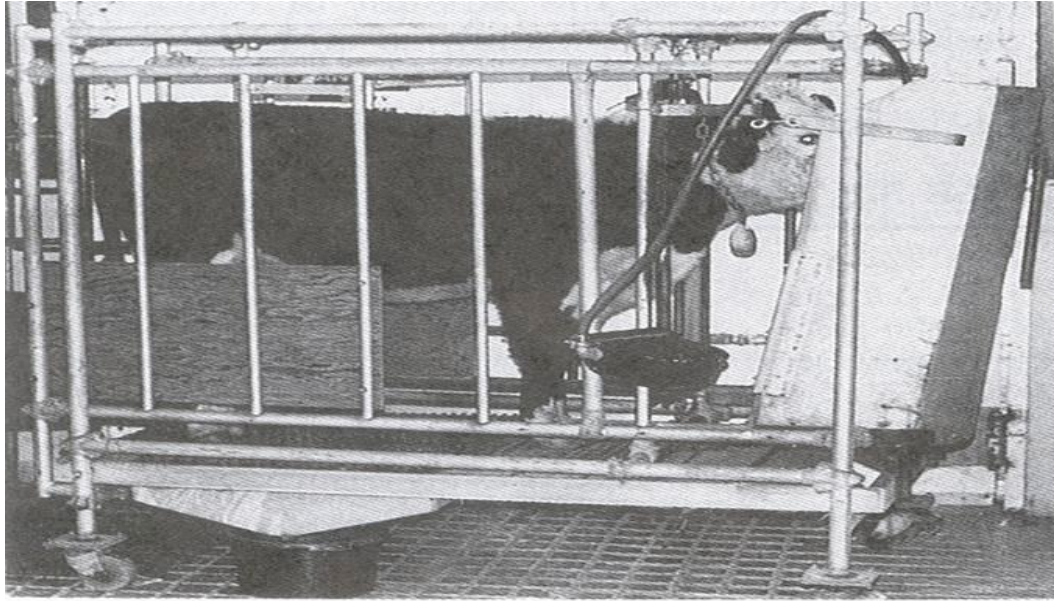


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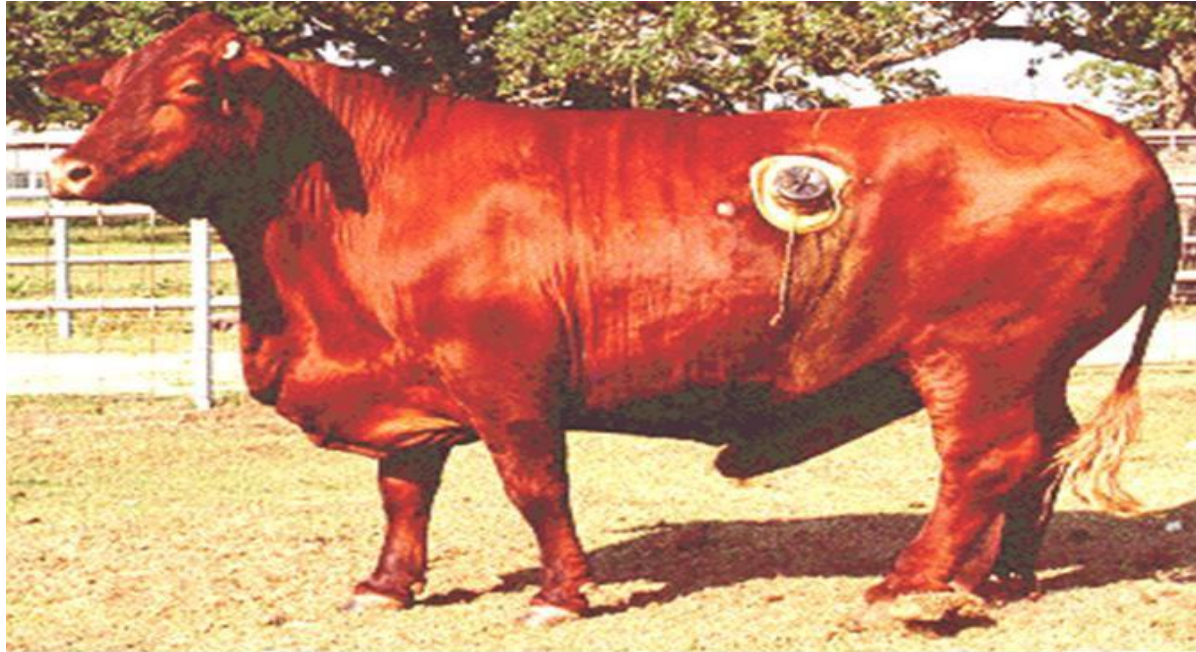
# Measuring Feed Components

- *In vivo*
  - Expensive but specific
  - Growth trials, indicator trials
- *In vitro*
  - Cheaper, not species specific
  - Chemistry, fermenters
- *In sacco*
  - Ruminant studies.









# Units

- SI units
  - MJ Energy
  - g/kg Protein
  - g/kg Fat
  - g/kg Fibre
  - mg/g or g/kg Vits & mins
- Other “units”
  - Cal / Kcal Energy
  - % Protein
  - % Fat
  - % Fibre
  - % mins
  - % DI