IMPORTANCE OF PROTEINS

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INTRODUCTION:

Proteins are complex organic compounds. They are macromolecules or bio molecules composed of amino acids linked by peptide bond or linkage. The constituent elements of proteins are,

- **Carbon :54%**
- **Hydrogen :7%**
- **Nitrogen :16%**
- **Oxygen :22%**
- **Sulphur :1%**
- **Phosphorus :0.6%**

They are macromolecules of high MW & consisting of chains of amino acids. Most of the proteins contain 16% Nitrogen which means Wt. of N_2 x 6.25. i.e 100/16 = 6.25. E.g. 0.2 gm N_2 in feed sample = 0.2 x 6.25 = 1.25 gm of protein

- Protein is essential for life
- Protein is the main building component of the body
- Protein forms the basic structure of each cell in the body

Structure of Protein:

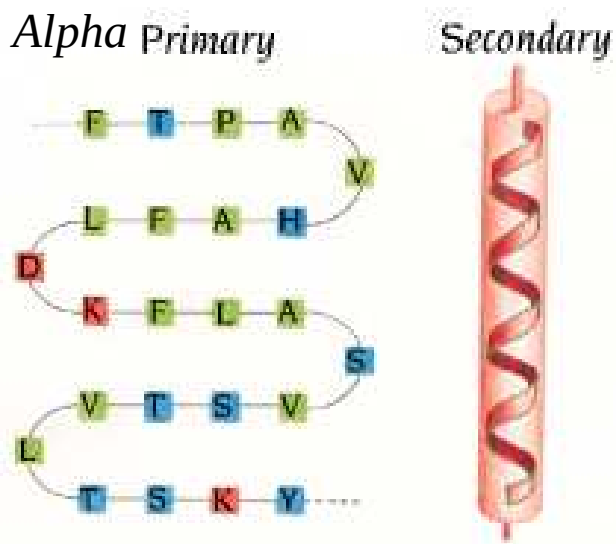
The basic unit of the protein molecule is **amino acids.** The protein molecules are composed of the union of a large number of amino acids. They all composed of different arrangements of main **20 fundamental amino acids.** The sequence of AA's in each protein is specific & is genetically controlled by the DNA of the cell.

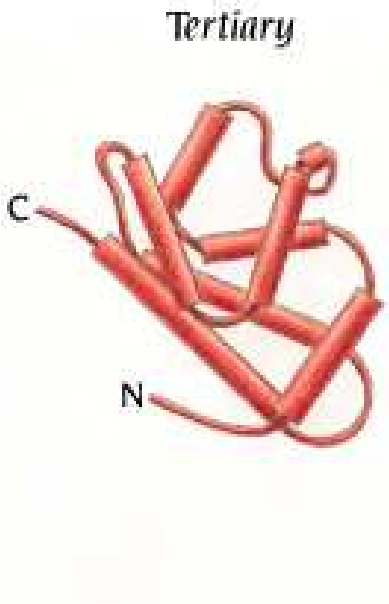
The synthesis of protein molecule takes place by the union of the **($-NH_2$) group** of one AA with the **(-COOH) group** of another AA.

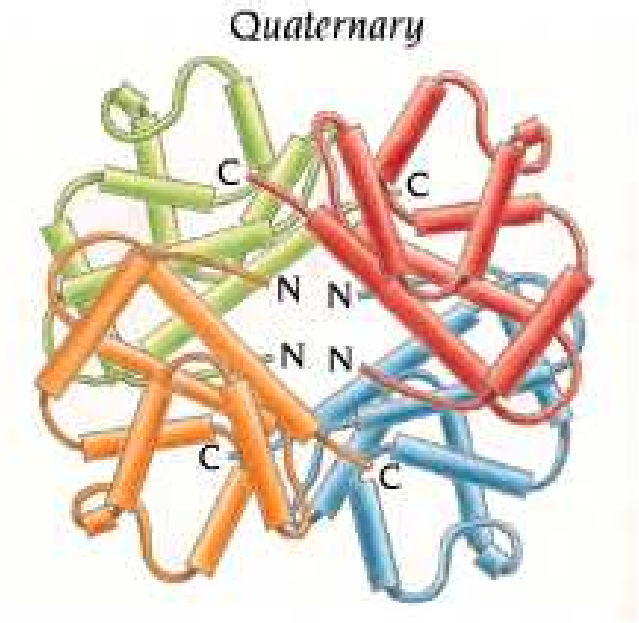
CH_2-CH.NH_2 + HNH.CH_2C COOH Amino group Carboxyl group | H_2N-CH.CH_2-CO-NH.CH_2COOH+H_2O $\rightarrow$ OOH (General formula of an amino acid).

According to the modern views, the structure of protein is considered by several level of organization.

Structure of Protein: Depending upon level of organization







•**α-Primary level:** **peptide bond** is formed by the amino acids. They are linked by **carboxyl group of one amino** acid with the **α-amino group of another amino acid** through **disulphide bonds.**

•**Secondary level**: **peptide bonds are folded which indicates a coiled structure** (e.g., globular proteins). In this folding, carboxyl & amino groups of peptide chains are linked by **hydrogen & disulphide bonds.** Such folding is known as secondary structure of protein.

•**Quaternary structure**: In this structure, there are several monomer units, each with appropriate **primary, secondary and tertiary structures may combine** through non-covalent interactions e.g., haemoglobin contains four subunits identical in pairs.

•**Tertiary structure**: when the globular protein consists of a **series of single helix.** These models will have elongated structures with a larger axial ratio (length : breadth). The structure in their dimensions is maintained by covalent or other bonds and described as tertiary structure.

Crude Protein

- True protein (60 to 80%)
  - Essential amino acids
    - Arginine (Arg)
    - Histidine (His)
    - Isoleucine (Ile)
    - Leucine (Leu)
    - Lysine (Lys)
    - Methionine (Met)
    - Phenylalanine (Phe)
    - Threonine (Thr)
    - Tryptophan (Trp)
    - Valine (Val)
  - Non-essential amino acids
    - Alanine (Ala)
    - Asparagine (Asn)
    - Aspartic acid (Asp)
    - Cysteine (Cys)
    - Glutamic acid (Glu)
    - Glutamine (Gln)
    - Glycine (Gly)
    - Proline (Pro)
    - Serine (Ser)
    - Tyrosine (Tyr)
- Non-protein nitrogen
  - Amides
  - Amines
  - Amino acids
  - Peptides
  - Nucleic acids
  - Nitrates
  - Ammonia
  - Urea
- Lignified nitrogen

Classification of Proteins: Proteins may be classified as following ways,

A. According to Structure

- **Fibrous** type with elongate molecule e.g., Keratin
- **Rounded type** with globular molecule e.g. Globular proteins
- **Intermediate type** like wool

B. According to Composition

- **Simple proteins** -e.g., albumins, globulins, histones etc.
- **Conjugated proteins**-e.g.nucleoproteins, lipoproteins, chromoprotiens, flavoproteins.
- **Derived protein** e.g., metaproteins, peptones

C. According to function

- **Enzymes type** - eg. Trypsinase, carboxylase, glutaminase.
- **Hormones type-e.g**., insulin, glucagon.
- **Transplant type** - e.g., haemoglobin, serum albumin.
- **Protective type** - e.g., antibodies, thrombin, fibrinogen.
- **Contractile type** - e.g., myosin, actin.
- **Storage type** - e.g., casein, ovalbumin.
- **Toxins type** - e.g., diphtheria toxin, snake venom.

Classification of proteins According to Composition

I. Simple proteins: on hydrolysis gives only amino acids. Depending upon the shape, solubility and chemical composition they are sub-classify as Fibrous proteins & Globular proteins.

Fibrous proteins

They are elongated
Carbon chain joined by cross linkage

e.g. **1. Collagen**: Connective Tissues
2. Elastin: Tendons & arteries
3. Keratins: Hair, hoof & wool

Globular proteins

Polypeptide chain folded into compact structure

e.g.1. Albumins
2. Globumins
3. Protamins
4. Histones

Albumins and Globulins:

Present in egg, milk and blood. They are proteins of high biological value i.e. contain all EAA and easily digested.

Globulins:

Types of globulins:

α1 globulin: e.g. Antitrypsin
α2 globulin: e.g. hepatoglobin: protein that binds hemoglobin to prevent its excretion by the kidney
β-globulin: e.g. transferrin: protein that transport iron

γ-globulins = Immunoglobulin (antibodies): responsible for immunity.

II. Conjugated proteins: On hydrolysis, gives protein part and non-protein part (Prosthetic group)
and sub classified into following;

1. Phosphoproteins: These are proteins conjugated with phosphate group. eg. Casein of milk and Vitelline of yolk.

2. Lipoproteins: These are proteins conjugated with lipids.
Functions: a- help lipids to transport in blood
b- Enter in cell memb. structure helping lipid soluble
eg. Lecithin, Chlorophyll, HDL and LDL

3. Glycoproteins: proteins conjugated with sugar (carbohydrate)
eg. Mucin, blood groups and erythropoietin(hormone)

4. Nucleoproteins: These are basic proteins (eg. histones) conjugated with nucleic acid (DNA or RNA).
eg. a. Chromosomes: are proteins conjugated with DNA
b. Ribosomes: are proteins conjugated with RNA

5. Metalloproteins: These are proteins conjugated with metals like iron, copper, zinc and sub-classify as,

a. Iron-containing proteins: Iron may present in **heme** such as in hemoglobin (Hb), myoglobin (protein of Muscles). Iron may be present in **free state** (**not in heme**) as in:

-Ferritin:
-Hemosidrin:
-Transferrin:

b. Copper containing proteins:
e.g. – Ceruloplasmin and cytochrome oxidase

c. Zn containing proteins: e.g. Carbonic anhydrase & Insulin

d. Mg containing proteins: e.g. Kinases and phosphatases

6. Chromoproteins: These are proteins conjugated with pigment. e.g.

- All proteins containing heme (Hb, myoglobin) & Melanoprotein

III. Derived proteins:

Produced from hydrolysis of simple proteins.

e.g. **Gelatin:** from hydrolysis of collagen

Peptone: from hydrolysis of albumin

Primary Derived

e.g. Metaproteins

Ca-coagulated protein

Secondary Derived

e.g. Proteases

Peptides

Peptones

Enzymes

Sources of Proteins:

Animal protein:

e.g. Meat, poultry, fish, eggs, milk, dairy products

Almost same proportion of each essential amino acid

— *Complete protein: high BV (Biological Value)*

Vegetable protein

Sources: e.g. vegetables, legumes, plants, grains, nuts, seeds

Deficient in 1 or more essential amino acids

— *Incomplete protein: low BV*

Deficient (poor) amino acid = *limiting amino acid*

Properties of Proteins:

- Proteins are **Amphoteric** in nature
- **Colloidal** or **crystallized** in nature. e.g Egg albumin, Keratin in wool
- **Soluble** in water, weak salt solution and dilute acids.
- Each protein possesses a specific **isoelectric point** (it is precipitated)
- **Optically active** (because - asymmetry of polypeptide chain & asymmetry of alpha carbon atoms in amino acid residues
- Most of proteins undergo **coagulation/denaturation** by heat or acids
- Proteins undergo denaturation by many kinds of chemical or physical treatment such as shaking, change of temperature, change of reaction, additional of neutral salts etc.
- They **differ** from one another in chemical structure, physical and physiological properties.

Function of Proteins:

- Protein forms the muscles & tissues of body; hence it is necessary for body building. About **17% parts** of adult body is made of up of proteins.
- Proteins helps in maintaining loss of body tissues & muscles i.e. **Tear & wear**
- It helps in **formation of enzymes, hormones & digestive juices** of body and **needed** for formation milk proteins, eggs, development & growth of chicks, wool, nail, hair etc.
- Proteins help in **repair of body cells** as well as formation of new cells.
- Proteins as enzymes – **accelerate/catalysts** the rate of metabolic reactions.
- As **hormones, growth factors** - perform regulatory functions and gene activators.
- Others - act as the **defense against infections** by protein antibodies, service as toxins, form blood clots through thrombin, fibrinogen and other protein factors, absorb or refract light and transport substances from one part of the body to another.
- Maintain **colloidal osmotic pressure** of blood-mainly induced by blood protein.
- Plays important role in **acid base balance** of extracellular fluids in body.
- They perform **hereditary transmission** by nucleoproteins of the cell nucleus.

What is Bypass Protein?

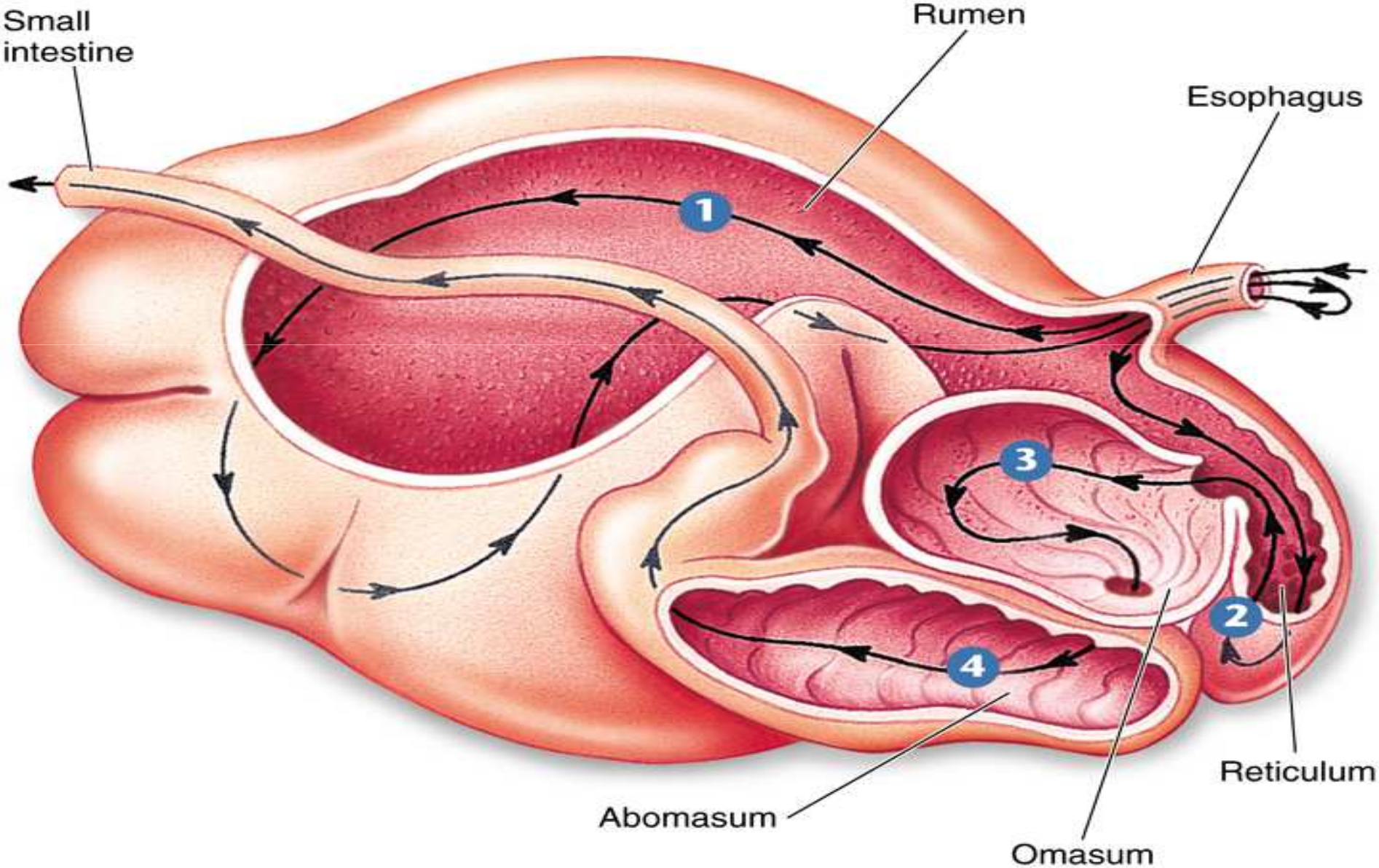
BY-PASS PROTEIN:

What is ‘By-pass’ protein?

Bypass protein is also called Rumen escape or Un-degradable Protein (UDP). It is the portion of the protein from a feedstuff (cottonseed meal) that escapes from being broken down in the rumen by microbes. Bypass protein passes relatively intact into the small intestine where it is digested by enzymes of the animal and directly used as a source of protein.

Definition: In clear terms, by-pass proteins are defined as the portion of the protein from a feedstuff that escapes from being broken down in the rumen by microbes and passes into the small intestine intact where it is then digested by enzymes and utilized by the animal as a source of protein. By-pass protein meals such as cotton seed meal are a by-product of extracting oil from the seed. The protein meal generated has passed through heat and physical treatments that modify its molecular structure and render it relatively unbreakable to microbes in the rumen. However, it is still digestible by the animal as a protein source in the small intestine. Hence the term “By-pass” protein as it by-passes the main site of protein digestion in the animal.

Normal path of morsel in Ruminants (Ruminant stomach)



Bypass Protein ....Cont

- A significant portion of feed proteins which ***escapes ruminal microbial degradation*** in the rumen are termed as bypass proteins or undegradable proteins (UDP).

- Escape digestion in rumen
- Passes intact to the lower digestive tract
- Digested and absorbed in lower GIT
- Provide dietary protein & amino acid directly to the animals.
- Higher quality
- Improve performance of livestock.

When to feed Rumen By-pass Protein?

More beneficial when the animal's requirement for protein is not met through microbial protein;

- In early lactation period of high yielders (15 kg / day)
- In rapidly growing (1kg / day) calves
- Animals thriving only on poor quality roughages
- Stressed animals

Specification for Bypass Protein

CHARACTERISTICS	%, DM basis
Moisture, % by mass, max	10
Crude Protein (N×6.25),% by mass , Min.	30
Ether Extract (EE), % by mass, min.	3.5
Crude Fibre (CF), % by mass, Max.	8.0
Acid Insoluble Ash (AIA), % by mass, Max.	2.5
Un-degradable Proteins (UDP), % by mass, Min.	20 (60-65%)
Rumen Degradable Proteins (RDP), % by mass , Max.	9 (30-35%)

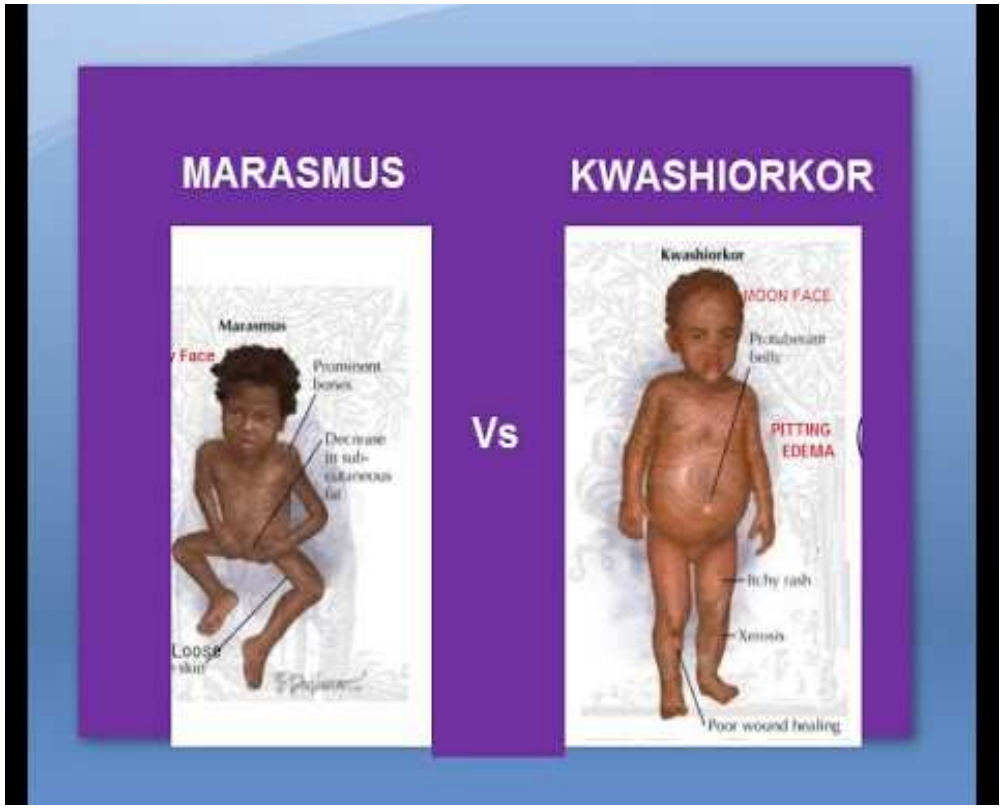
Source: NDDB, Anand

Significance of By-pass Proteins

- Increases availability of EAA's
- Easier to meet the requirement of high yielding animals
- Increase **growth rate** by 25-30% (Chatterjee and Walli, 2003)
- Early age at first calving
- Increases **milk yield** about 10% (Walli and Sirohi, 2004)
- Improvement in fat & SNF percent Improve productive efficiency
- Help in increasing net daily income
- Better resistance against diseases

Protein Deficiency Diseases:

- Kwashiorkor (Protein malnutrition)
- Marasmic – Kwashiorkor (Energy & protein deficiency)
- Negative nitrogen balance.
- Abdominal enlargement
- Vomiting
- Diarrhoea
- Nephrosis
- Oedema



THANK YOU