IMPORTANCE OF NUTRIENTS –LIPIDS / FATS

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Introduction: Lipids (Fats)

Plant and animal body contains certain material which is **insoluble** in water but **soluble** in benzene, chloroform, ether and it contains C, H, O, N, P is called as lipids or fats. Lipids are included as **ether extract (EE) fraction** in proximate analysis. In the plant material there are two types of lipids,

•**Structural Lipids**: They are present in various membranes of plant cell (7%). They mainly acts as **protective surface layers** (waxes, fatty acids & cutins) and **membrane lipids** are mainly glycolipids, phospholipids.

•**Storage Lipids:** Storage lipids mainly present in fruits, seeds, predominantly in oils and fats. In animals about 9% of storage lipids are present in adipose tissues. The yield of energy from complete oxidation of fat is **9 kcal / g (39 MJ/ g DM** as compared to 4 kcal /g (17 MJ / g DM from glycogen / proteins).

Composition of Fats / Lipids

It is important in nutritional investigation to check the quality of fat. It is being produced by certain treatments which results into softing / harding of fats. The glycerol is the common in all fats. The gas chromatography is used for analysis of fats. The gas chromatography accesses the quality of fat more easily and accurately.

General composition of lipids:

•**Plants & Marine Lipids**: Plants & marine contains highly unsaturated fats (linolenic, linoleic & oleic acids) than the mammalian origin.
e.g.: rape seed; castor bean

•**The Mammalian Depot Fats:** In this the proportion of saturated fatty acids (as palmitic, stearic acids, lauric, myristic acids). That's the reason fats like lard, beef and mutton tallow are firm & hard in consistency whereas plant, fish origin fats are softer & oils in true sense.
e.g : Milk fat

Function of Fats / Lipids

- Lipids are concentrated fuel reserve / energy of body.
- Lipids give 2.25 times more energy as compared to carbohydrates.
  1 gm of fat gives 9.3 Kcal heat (39 MJ/ g DM).
- They serve as the source of fat soluble vitamins e.g Vitamin A, D, E, K
- Provides EFA i.e. Linoleic, Arachidonic, Linolenic acids to animal body.
- Fats are essential component of milk, growth and development of body.
- They protect the internal organs, as they serve as insulating material and are essential for lubrication of joints and imp for nervous system.
- They give shape and structure to the body
- Lipid helps in regulation of body temperature.
- They are constituents of membrane structure & regulate its permeability.
- Lipids are important cellular metabolic regulators.

Classification of Fats / Lipids

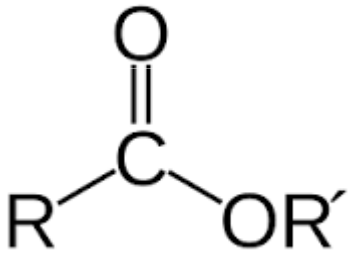
Fats are classified into 4 categories as follows:

1. On the basis of chemical composition

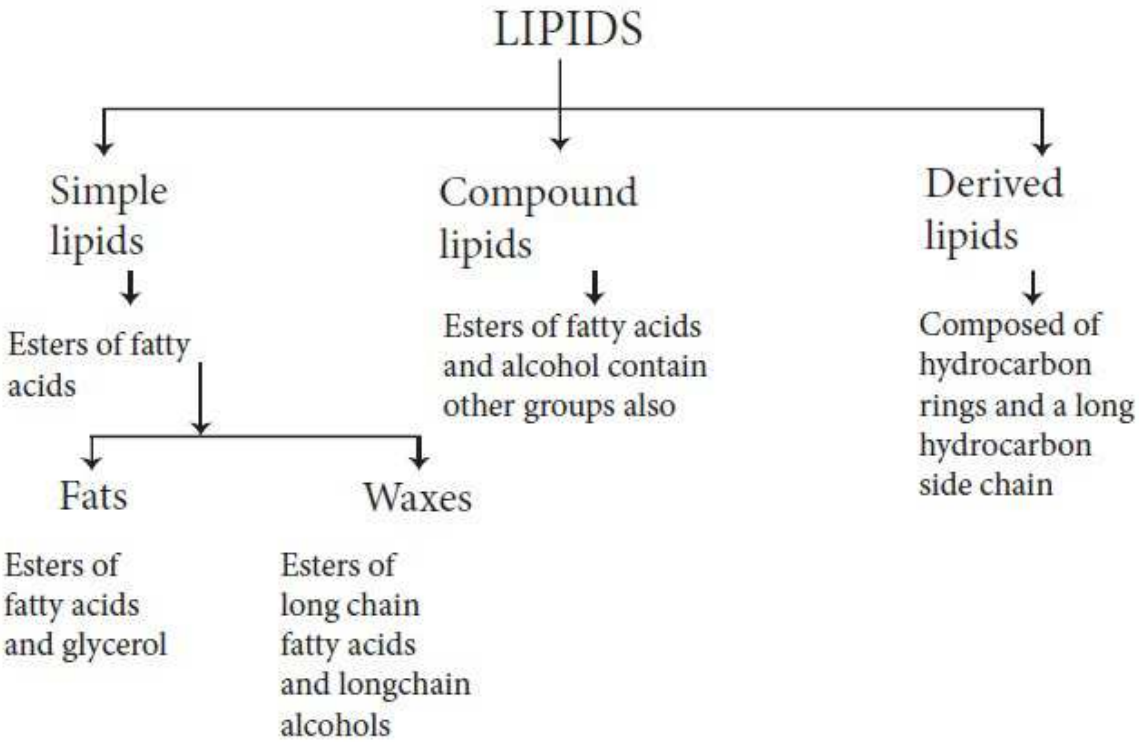
2. On the basis of fatty acids

3. On the basis of requirement & 4. On the basis of sources

1. On the basis of chemical composition:



An **ester** is a chemical compound derived from an acid (organic or the inorganic) in which at least one –OH (hydroxyl) group is replaced by –O–alkyl (alkoxy) group. Usually, **esters** are derived from substitution reaction of a carboxylic acid and an alcohol.



Classification of fats on the basis of chemical composition

Fig 10.15: Classification of fats based on fatty acids

1. Simple lipids

These are esters of fatty acids and glycerol. They are also called as **neutral fats or triglycerides.** These neutral fats make up 98-99% of food and body fats, e.g fats, oils & Waxes. A wax is a simple lipid. Waxes are found in nature as coatings on leaves & stems. The wax prevents plant from losing excessive amounts of water.

2. Compound lipids

The compound lipids contains fatty acids & glycerol, with some other organic compounds (phosphoric acid, CHO & proteins). They are sub-classified as,

1.Phospholipids: These lipid contains phosphoric acid and a nitrogenous base in addition to fatty acids and glycerol, e.g. lecithin and cephalin

2.Glycolipids: Complex lipids containing carbohydrates in combination with fatty acids and glycerol, e.g. Cerebrosides

3.Lipoproteins: Lipoproteins are the most important lipids as they are the carriers of lipids in the blood and form cell membranes.




Simple Lipids: Plant fats / oils & Bees wax

Rape seed Lecithin

Soyabean Lecithin

Compound Lipids

3. Derived lipids

These are substances liberated during hydrolysis of simple and compound lipids. The important members of this group are sterols, fatty acids and alcohols.

i. Sterols : Sterols are solid alcohols and form esters with fatty acids. Based on their origin sterols are classified as cholesterol (**animal origin**) and phytosterol (in **plants**). Cholesterol is a waxy, fat-like substance found in all cells of body and has several important functions. It is synthesized in body by liver independent of dietary intake. The body normally synthesizes about 2 gm of cholesterol. The dietary sources of cholesterol includes animal foods. It is used in body for synthesizing hormones, Vitamine D and substances which help digest foods. High blood cholesterol is a risk factor for heart disease. Rich sources of cholesterol includes meat / chicken, organs like brain, kidney, liver & full fat dairy products.

ii. Fatty acids: They are the key, **refined fuel form of fat** that the cell burns for energy. They are the basic structural unit of fats & they may be saturated or unsaturated, e.g. Oleic / linoleic / linolenic / palmitic acid and myristic acid.

2. On the basis of fatty acids

Fats can be classified based on the fatty acids present in them as follows,

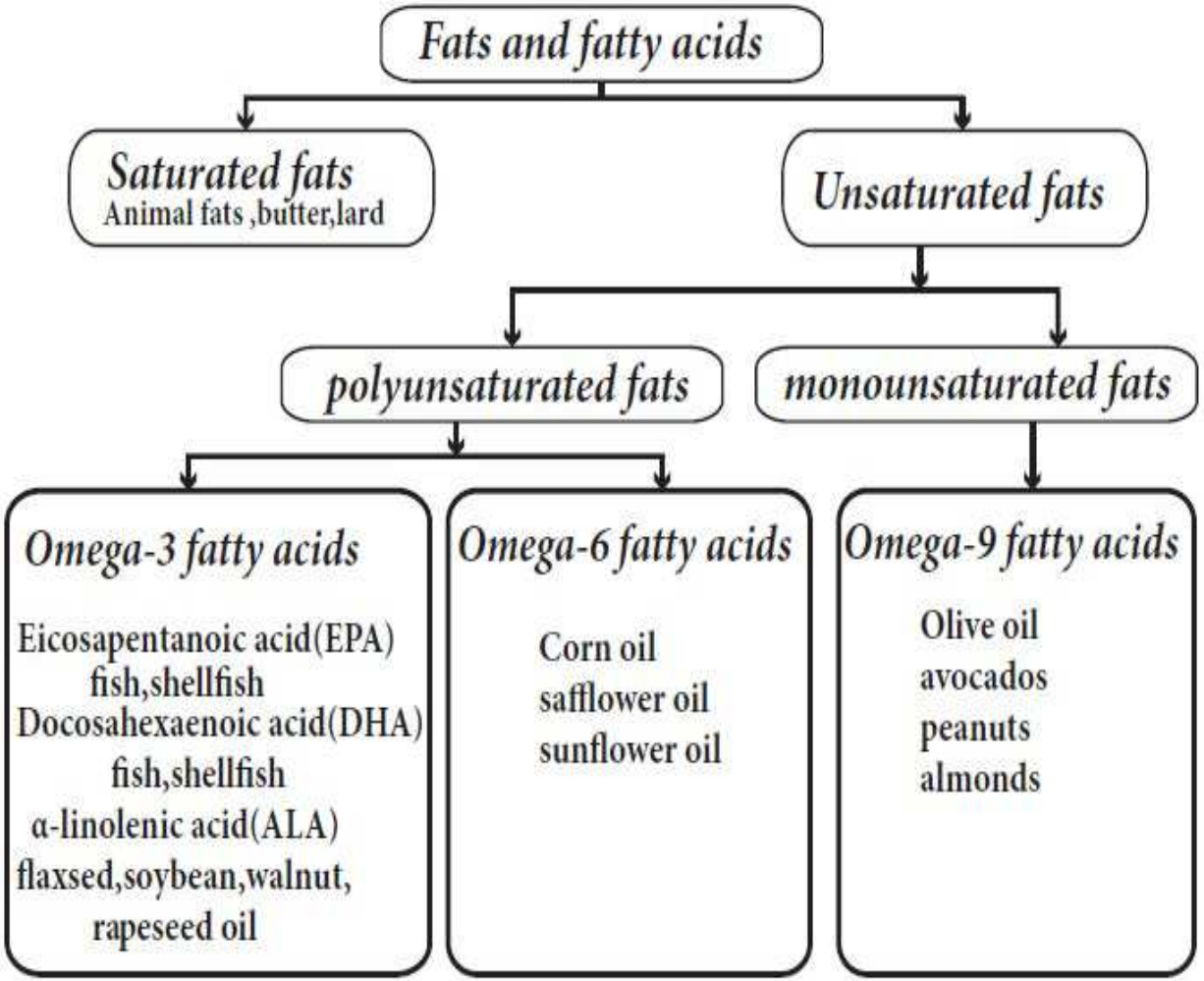


Fig 10.15: Classification of fats based on fatty acids

1. Saturated fatty acids

A saturated fat is a type of fat in which the **fatty acid chains** have all or predominantly **single bonds.** Various fats contain different proportions of saturated fat. Saturated FA, especially **palmitic & stearic acids** are found in animal products such as **cream, cheese, butter, other whole milk** dairy products and fatty meats also contain dietary **cholesterol.** Certain vegetable products have high saturated fat content e.g. **coconut oil and palm kernel oil.** Many prepared foods e.g. **pizza, dairy desserts.**

Fig 10.14: Food sources of Saturated fats

2. Unsaturated fatty acids

An unsaturated fat is a fat or fatty acid in which there is at **least one double bond within the fatty acid chain**.

i. **Monounsaturated fatty acid (MUFA):** A fatty acid chain is monounsaturated if it contains one double bond. MUFA are **good fats**. A diet high in MUFA can **reduces** blood cholesterol levels, lowers risk of heart disease, stroke and breast cancer, reduces pain in rheumatoid arthritis and helps in weight loss. Foods which contain MUFA (Oleic acid) are **avocados, olive oil, peanut butter and peanut oil**. It is also known as **omega-9 fatty acid.**

(ii) Polyunsaturated fatty acid (PUFA): A fatty acid is polyunsaturated if it contains **more than one double bond within fatty acid cain**. They are of **2 types, namely Omega-3 & omega-6 fatty acids.**

a. Omega-3: It is also called ***ω-3*** fatty acids or ***n-3*** fatty acids with a double bond (C=C) at 3rd C atom from the end of carbon chain. The **three types of omega-3** fatty acids involved in human physiology are **α-linolenic acid** (ALA, in plant oils e.g walnut, flaxseed, flaxseed oil, soybeans). **eicosapentaenoic acid** (EPA), and **docosahexaenoic acid** (DHA) (both in marine oils e.g fish and fish oils)

The health **benefits of omega-3 fatty acids** are immense and they have been proven effective in the treatment and prevention of hundreds of medical conditions which includes high **cholesterol, depression, anxiety, cancer, diabetes mellitus, inflammatory diseases, arthritis and cardiovascular diseases**.

Fig 10.16: Rich sources of omega-3 fatty acids

b. Omega-6: Omega-6 fatty acids (also referred to as ω-6 fatty acids or n-6 fatty acids) are a family of pro- inflammatory and anti-inflammatory polyunsaturated fatty acids that have in common a **final carbon-carbon double bond in the n-6 position, that is the sixth bond, counting from the methyl end.**

Omega-6 fats, also known as **linoleic acid**, are available only in food. Good sources of linoleic acid include vegetable oils. The human body cannot make them, so they are **considered essential fats**.

They support **brain function, bone health, reproductive health, hair growth and regulation of metabolism.**

Fig 10.17: Rich sources of omega-6 fatty acids

3. On the basis of requirement

Fatty acids are of **2 types**:

1. Essential fatty acids

Fatty acids which are **essential to be taken in our diet** because they cannot be synthesized in our body are known as essential fatty acids.

e.g. 1. Linoleic
2. linolenic
3. Arachidonic acids.

2. Non-essential fatty acids

Non-essential fatty acids are those which **can be synthesized by body** and which need not be supplied through the diet.

e.g. 1. Palmitic acid
2. Oleic acid
3. Butyric acid are

4. On the basis of sources

Fats are divided into **2 types** based on their source, namely **visible and invisible fats**. Some fats and oils added to food or used for frying are **visible fats.** These are also known as **pure fats**.

Many foods like milk, cream, egg yolk, meat, fish and even cereals and legumes contribute substantial amount of **invisible fats (not visible in the food)** to the diet.

Fig 10.18: Sources of visible and invisible fats

Bypass Fat ????


GopiLac
RUMEN BYPASS FAT
SUITABLE FOR ALL TYPES
OF RUMINANTS
GopiLac

Why Bypass Fat...??

Energy deficient ration (crossbred cows & high yielding buffaloes during early lactation)

Limited amount of fodder & energy rich supplements

Animal loose body wt. after calving with faster rate (up to 80-100kg)

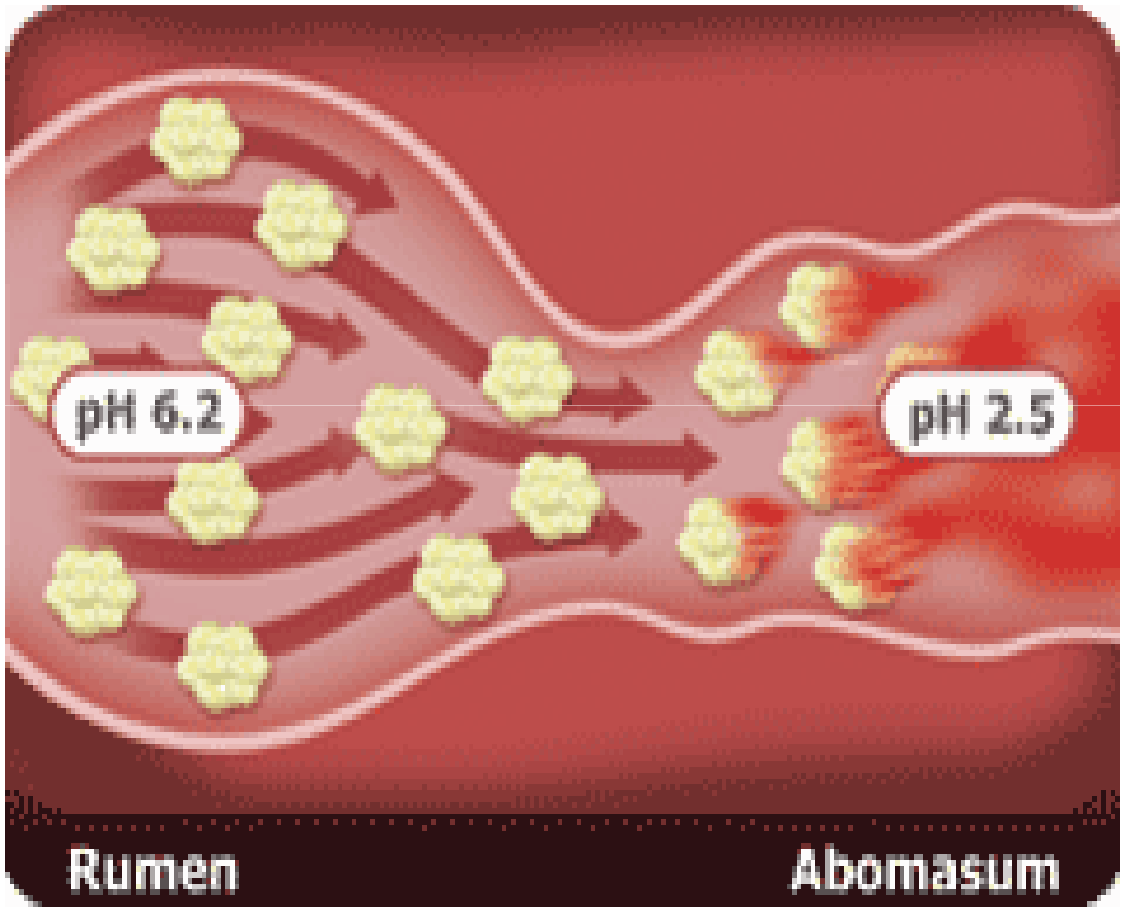
Debilitated animals

Infertility, delayed conception, more intercalving period

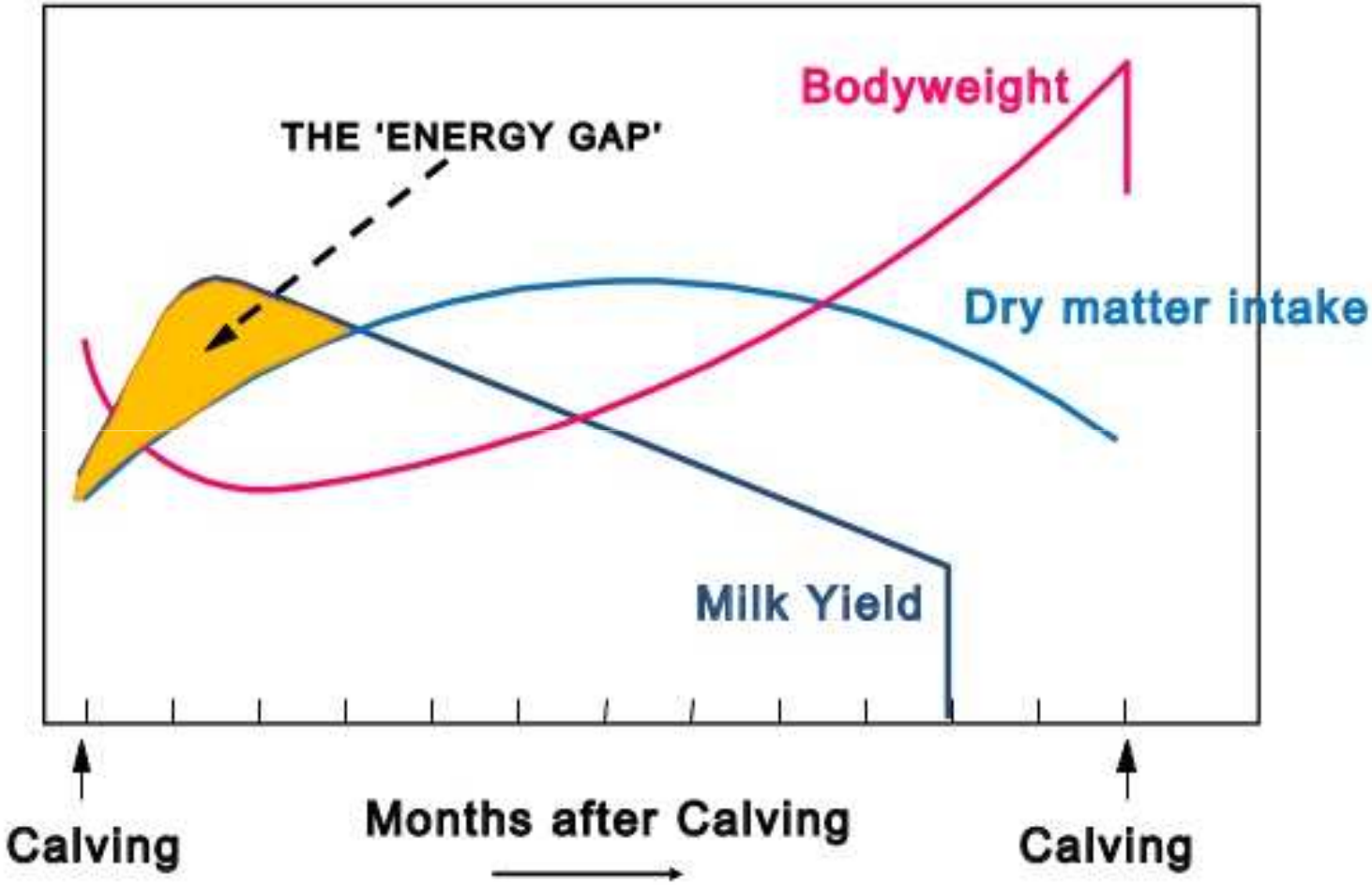
Less milk/lactation yield

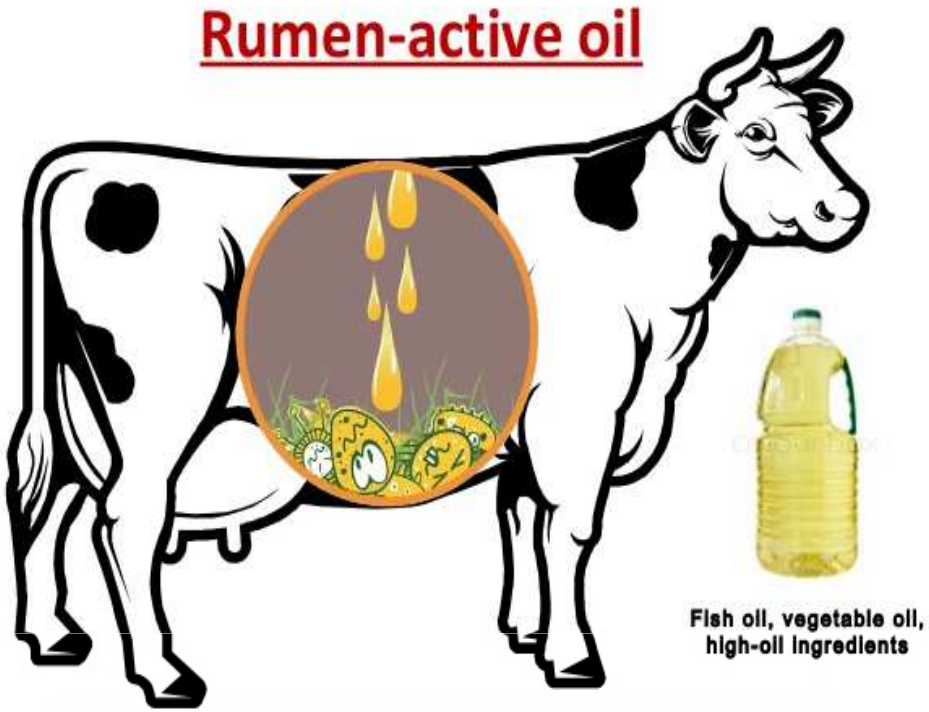
→ ***Economic losses***

By-Pass Fat



Rumen-protected fat – filling the energy gap





Therefore, it is necessary to supplement fat in such form which can provide Energy *without affecting fibre digestion* in rumen. This should possible if fat is supplemented in rumen *protected form which does not affect fibre digestion in rumen*.

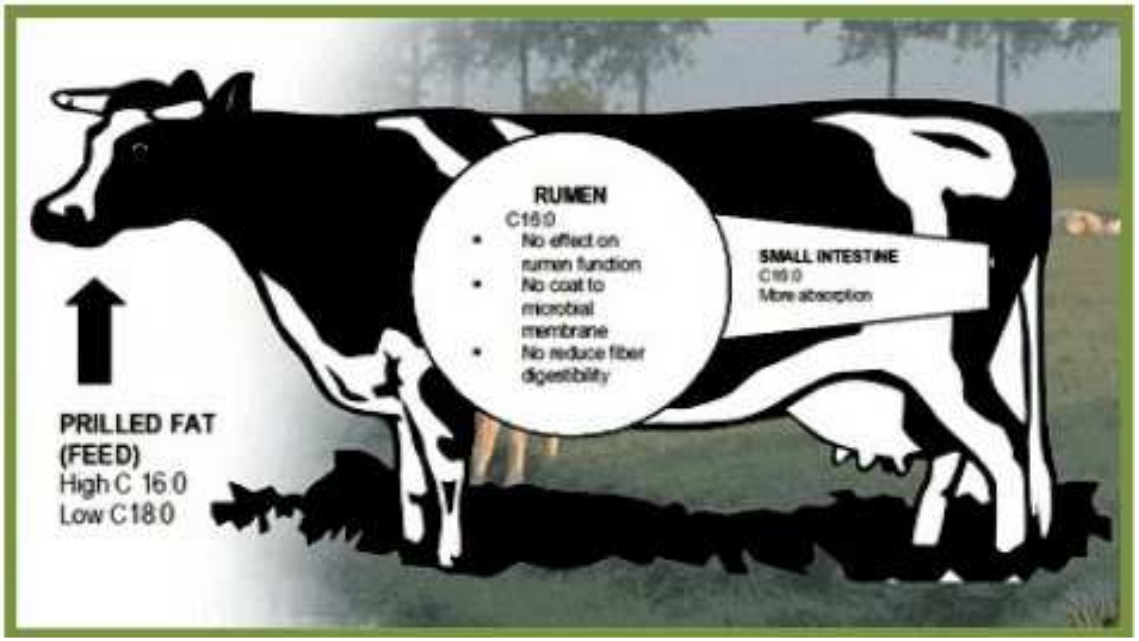
Raw edible oil *increases* energy density of feed

Certain value

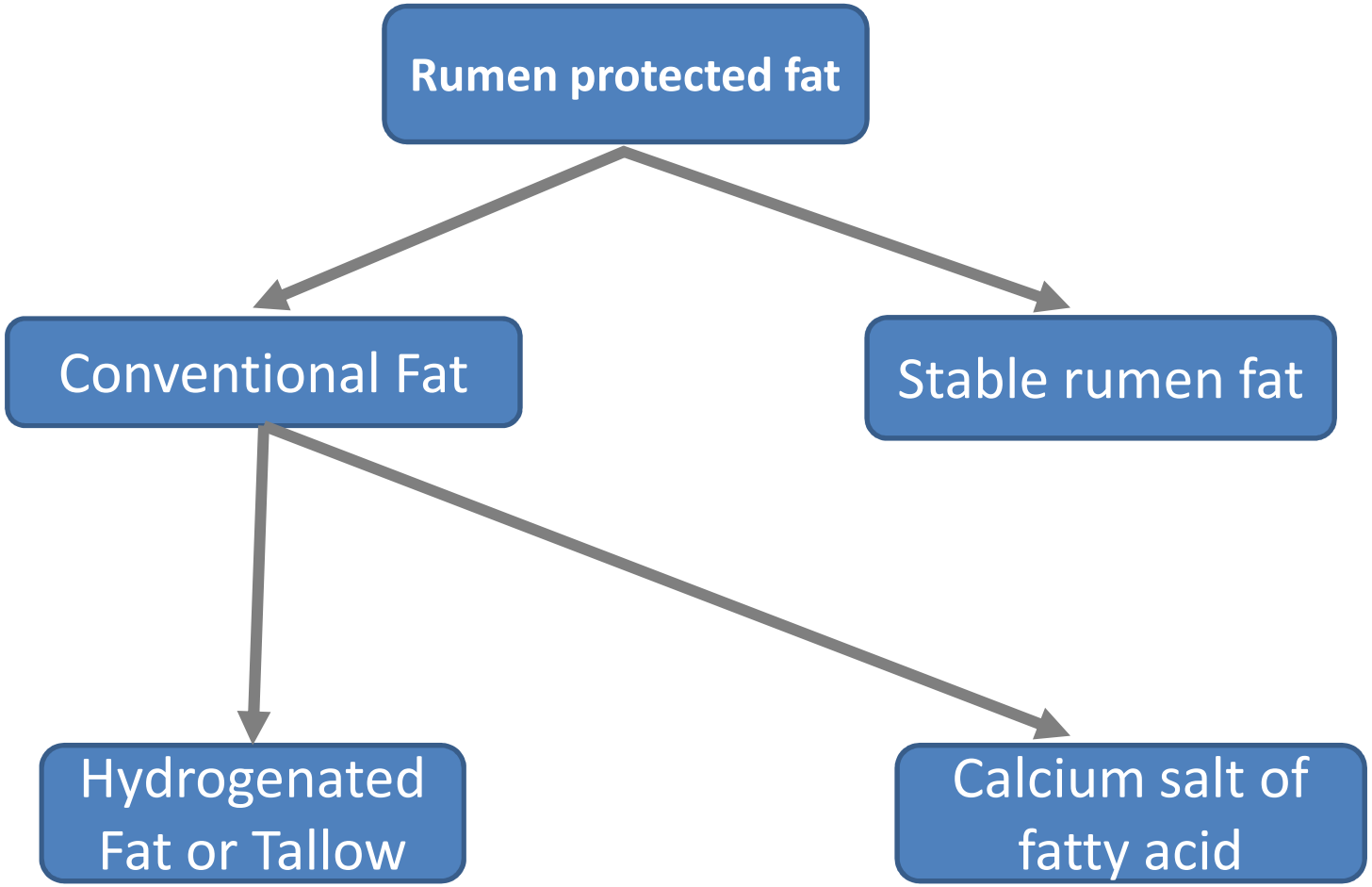
Affect ***Microbial activity***; ***fibre digestion &*** ***bind divalent mineral ions***

Rumen Bypass Fat

- High Melting Point
- Insoluble at rumen temp
- Inert to rumen pH
- No harmful effect on rumen fermentation

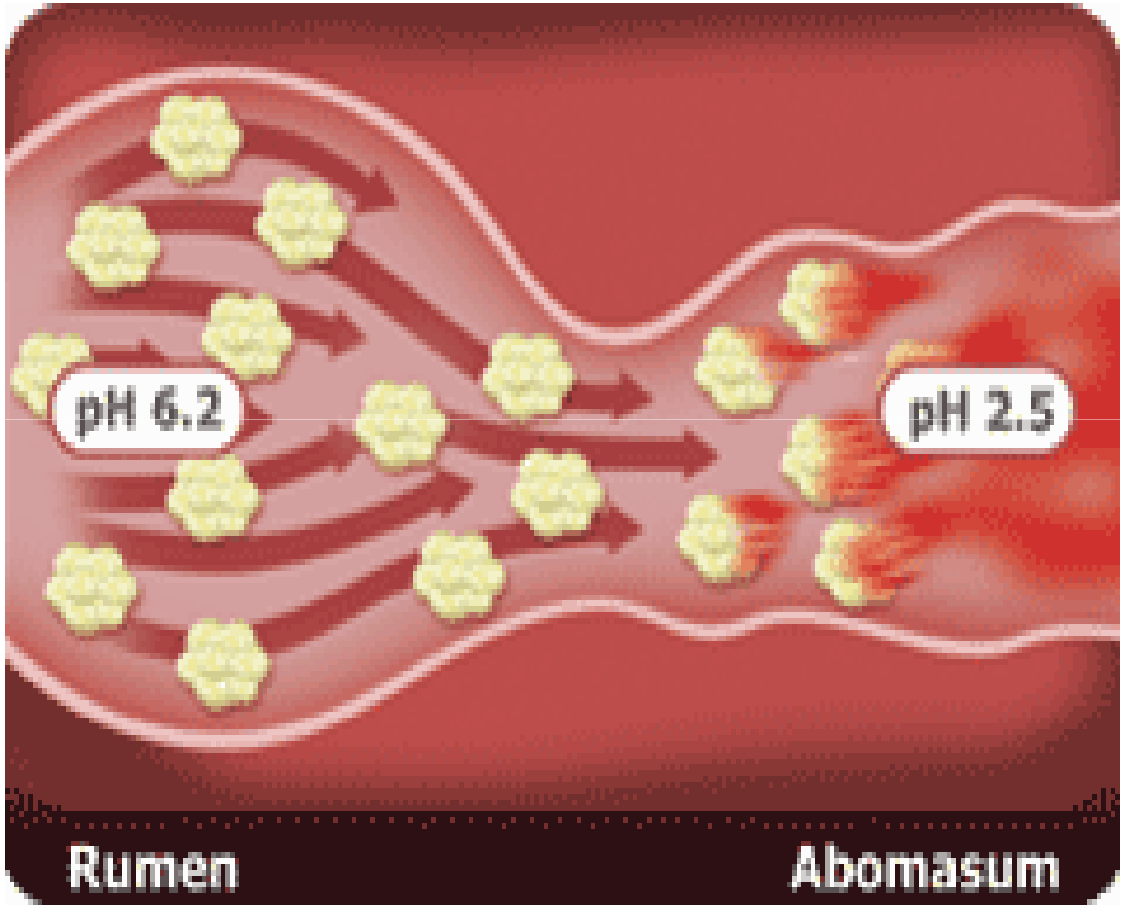


TYPES OF RUMEN PROTECTED FAT



Passage of By Pass Fat

- Quite stable at alkaline pH.
- By-passes Rumen.
- Gets dissociated only at abomasal PH
- Delivers essential fatty acids at the site of absorption.
- Maintains Energy levels specially in High Yielder and pregnant cattle.



By Pass Fat: Fatty Acid Profile

	% of Product as Fed
C 12:0, C 14:0	1.2 %
C 16:0 (Palmitic)	48 %
C 18:0	5 %
C 18:1 (Oleic)	36 %
C 18:2 (Lenolenic)	9 %

THANK YOU