University of Mosul
Lecture No.: 6
College of Veterinary Medicine
Date: first term/ 2026-2027
Unit of Scientific Affairs
Website: https://uomosul.edu.iq/veterinarymedicine/

Lecture title: **Animal nutrition: Lipid Digestion and Metabolism**

Lecturer Affiliation: *Professor, Dr.* ***Muntaha Ghazi Hasan***

Department of Public Health,College of Veterinary Medicine, University of Mosul, Mosul, Iraq
https://orcid.org/ 0000-0001-7250-0117

Summary:

Lipids Metabolism

The lipids are a group of substances found in plant and animal tissues. They are insoluble in water but soluble in common organic solvents such as benzene, ether, and chloroform. they are included in the ether extract fraction In the proximate analysis of animal feeds. Usually, the diet of cattle contains about 2-4 % lipids and contribute 50% of milk fat. They are present in small amounts in most natural feedstuffs available for animal feeding, except oilseeds. the relationships between fat in the diet and fat in the products are different in single-stomached animals and in ruminants, in young and adult animals.

Lipids functions

1- As substrate carriers in enzymic reactions.
2- As components of biological membranes.
3- As sources of energy.
4- play an important role in improving the absorption of fat-soluble vitamins.
5- Adding oils to rations reducing the powderiness of feed.
6- Affect the fat quality and quantity of milk fat.
7- Affect the fat quality of meat.

Plant lipids are of two main types:

- Structural lipids
- Storage lipids

Natural fats are consisting of three fatty acids and one glycerol components. Fatty acids are usually classified as saturated fatty acids (SFA), unsaturated fatty acids (USFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA). Among the polyunsaturated fatty acids group, linoleic (LA) and linolenic (LNA) fatty acids are the essential fatty acids.

The major lipid constituents in dairy cattle nutrition are:

1-**Triglycerides**: major lipid type found in cereal grains, oil seeds animal fats and byproduct feed.

2-**Glycolipid**: major lipid type found in forages.

3-**Phospholipids**: from the cell membrane and the surface of milk fat globulin.

4-**Free fatty acids** Common fatty acids found in the diet of dairy cows are:

- Saturated fatty acids: which includes (myristic , palmitic and stearic acids)
- Unsaturated fatty acids : included (oleic , linoleic and linolenic acids

The main properties of fats are:

- Hydrolysis
- Oxidation
- Hydrogenation

Lipid metabolism

lipid consumption by herbivores animals is low because most forage contains only limited amounts .in the rumen , the microbes do not greatly alter the fat fraction , although some lipids may be synthesized . when fed low to moderate levels of dietary fat , the rumen microorganisms hydrolyze fat , producing free fatty acids and glycerol . rumen microbes modify the unsaturated fatty acids by either saturating them or causing changes in the location of double bond . the rumen microbial population is intolerant to high dietary levels of fat . when fat is added to the diet , it fed normally at no more than 5-7 % of the total diet . Stearic acid is the predominant fatty acid of ruminant fat deposits due to rumen flora activities. The capacity of rumen microflora to digest lipids is strictly limited. lipid contents of ruminant diets is normally (< 50 g/kg DM). If lipid content is increased (>100 g/kg DM)(= 10%) the rumen flora reduce their activity. This leads to:

- Decreased fermentation of carbohydrates
- Reduced intake of DM

Dietary lipids are extensively hydrolyzed in the rumen, by microbial enzymes originating first from different classes of bacteria (of which the best known is Anaerovibrio lipolytica) second from protozoa and to less extent fungi. These enzymes are :

- Lipases
- galactosidases
- phospholipases

These enzymes lead to the formation of free fatty acids (FA),This lipolysis is very rapid, lipolysis is reduced with diets rich in starch due to the low pH. The bacteria in the rumen split the fatty acid from the glycerol backbone called as lipolysis, then the released fatty acids undergo hydrogenation, lipase enzyme secreted from bacteria involved in this lipolysis. The glycerol released from glycolipids are fermented to volatile fatty acids principally propionic acids and butyric acids. Salivary lipase present in ruminants has a very low activity while in mono gastric animals play a more important role. Synthesized and assimilated fatty acids are esterified as phospholipids and sterol esters and constitute structural lipids. When large amounts of fatty acids are fed, they are stored as free fatty acids in cytosolic droplets, the effect of fat on digestion in rumen depend on :

1. The amount of fat
2. The nature of fat

3. The nature of basal diet
4. The amount of soluble Ca in the rumen
5. The animal species

Lipid Absorption

In ruminants, fatty acids reaching the duodenum are mainly adsorbed , desorption occurs with bile salts and lysolecithins which allow their solubilization in a micellar phase. These micelles allow lipid absorption at the jejunum. In epithelial cells of the small intestine, fatty acids are esterified, triacylglycerols and phospholipids are incorporated into chylomicrons which are transported by the lymph and, with diets rich in fat, in part by the portal vein.

In non-ruminants, lipids are emulsified and reach the duodenum as triacylglycerols and phospholipids and, for herbivorous species such as horses, as galactolipids. Biliary salts allow the adsorption of co-lipase at the lipid water interface, then the action of the pancreatic enzymes, lipase, esterases and phospholipases. the action of pancreatic lipase on triacylglycerols releases two fatty acids and a monoacylglycerol .These compounds form micelles with biliary salts and are then absorbed.

Micelles are bilayer disk consisting of bile salts and phospholipids and the insoluble lipid in the middle micelles are need to move the fatty acids to the surface of intestinal cells where they can be absorbed. After absorption the fatty acids are reconverted to triglycerides by combining with glycerol produced from metabolism of blood glucose. Then coated with proteins to form triglycerides rich lipoprotein then delivered to various organs of the body like mammary gland, muscle and heart.

