



LIPIDS AND METABOLISM

Assoc. Prof. Özge SIZMAZ

University of Ankara Faculty of Veterinary Medicine Department of
Animal Nutrition and Nutritional Diseases, Ankara, Turkey

Lipids



Lipids are organic compounds that are found in plant and animal tissues and are insoluble in water but soluble in non-polar solvents such as ether, acetone, chloroform and benzene.

Fat, such as carbohydrates, can also be carbon, hydrogen and oxygen

But their carbon and hydrogen content is much higher than carbohydrates.

Lipids can also be described chemically as esters, which are simply fatty acids made with glycerol or certain alcohols.



Structural Composition and Classification of Lipids



As a basic chemical structure, lipids are composed of glycerol and fatty acids.

Lipids are named according to the number of fatty acids combined with glycerol in the molecular structure. According to this,

When a molecule glycerol is combined with a single fatty acid, monoglyceride (monoacylglycerol)

when a molecule glycerol is combined with two fatty acids, the diglyceride (diacylglycerol)

a molecule glycerol, triglyceride (triacylglycerol) if it is combined with three fatty acids,

98% of the lipid in feed fats and animal organs is in the form of triglycerides.



Structural Composition and Classification of Lipids



In the classification of lipids, their chemical structures are taken into account.

Accordingly, lipids;

1. Containing glycerol
 - a. Simple (Fats, neutral fats or tryglycerides)
 - b. Complex (Fosfolipids, Glucolipids, Lipoproteins)
2. Does not include glycerol (Steroids, Sphingomyelines, Terpens)



Importance of Lipids in Animal Nutrition



1. They give more energy than carbohydrates and proteins.
2. Essential fatty acid source.
3. Make Vitamin A, Vitamin D, Vitamin E, Vitamin K source
4. Lipids play a role in many functions of fat-soluble vitamins.
5. Lipids have a special role on poultry nutrition, especially in the feeding of heat stressed poultry, due to the low metabolic temperature.





Fatty Acids

- Fatty acids are a chain formed by the side chains of the carbon atoms of the methyl (CH₃) group at one end and the carboxyl (COOH) group at the other end.
- They are esterified in the structure of natural oils. The nonesterified form is called free fatty acid (NEFA).



Classification of Fatty Acids



Fatty acids can be classified according to their carbon chain or saturated-unsaturation situation:

1. Fatty acids according to carbon number;
2. Short chains: Those with carbon numbers 2 and 4,
3. Middle Chains: Carbon numbers between 6 and 12,
4. Long chains: are those with carbon numbers between 14 and 22,
5. Very long chains: Carbon number between 24 and 26



Classification of Fatty Acids



Fatty acids can also be classified as essential fatty acids and non-essential fatty acids, depending on their essence properties.

1. Saturated fatty acids: there is a single bond between the C atoms
 2. Unsaturated fatty acids: double bond
 - a. If the number of C is less than 10
 - b. If the number of C is more than 10
- ❖ Mono Unsaturated Fatty Acid (MUFA): contains a double bond- oleic a.
 - ❖ Poly UFA (PUFA): more than 1 double bond- Linoleic and Linolenic a.



Classification of Fatty Acids



Because saturated fatty acids are difficult to absorb, their energy is less than unsaturated fatty acids.



Essential Fatty Acids



1. Linoleic (**C18:2 ω -6**) acid, Omega 6
2. Linolenic (**C18:2 ω -3**) acid, Omega 3
3. Arahidonic acid (**C20:4 ω 6**)



Conjugated Linoleic Acids (CLA)



- ✓ They are not found naturally.
- ✓ Hydrogenation of unsaturated fatty acids during microbial activity occurs as cis 9 and trans 11 isomers of the resulting linoleic acid (C18: 2).
- ✓ The mixture of these two isomers is called conjugated linoleic acid. Significant levels in ruminant muscles and sows located.

Linoleic a. – CLA- Trans f.a. – stearic a.



What is the reason for the requirement of essential fatty acids in poultry and pigs and the few symptoms of deficiency in ruminants?



1. Oil seeds are generally rich in linoleic and linolenic acid
2. The grass hays are rich in linoleic and linolenic acid.



What are the quality criteria?



1. Melting point
2. Number of iodine (is a sign of degree of unsaturation)
3. Number of saponification (determine the degree of purity)
4. Hydrolysis
5. Oxidation
6. Hydrogenation





Hydrogenation

The addition of hydrogen to the double C-bond in unsaturated fatty acids results in the formation of saturated fatty acids having the same carbon atom.

Examples: Stearic acid is formed by oleic acid hydrogen bonding.





Effects and Benefits of Adding Oil To Rations

- ✓ It is an energy source
- ✓ By entering into the structure of phospholipids and lipoproteins, it provides membrane permeability and stability
- ✓ It plays a helpful role in showing the functions of nerve cells
- ✓ It plays a role in the transport and absorption of fat soluble vitamins in the body to various organs and tissues
- ✓ It is an essential fatty acid source, especially linoleic acid,





Effects and Benefits of Adding Oil to Rations

- ✓ It plays a role in obtaining a homogenous feed mixture in the feed plant
- ✓ Prevents or reduces powder in feed
- ✓ It increases the flavor of the feed and makes it easier for the animals to consume
- ✓ It facilitates the function of the feed crushing and mixing machine and prevents its abrasion
- ✓ It facilitates pellet construction
- ✓ It is effective in meeting the energy needs because it reduces feed consumption in hot stress.

