



Organic Chemistry IV

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Properties of Lipids

- **Lipids** may be either liquids or non-crystalline solids at room temperature.
- Pure **fats** and oils are colorless, odorless, and tasteless.
- They are energy-rich organic molecules.
- Insoluble in water.
- Soluble in organic solvents like alcohol, chloroform, acetone, benzene, etc.
- No ionic charges.

Saponification number

- The saponification number is the number of milligrams of **potassium hydroxide** required to neutralize the fatty acids resulting from the complete hydrolysis of 1g of fat.
- Saponification **value** of fat/oil.
- Saponification is the process by which the fatty acids in the triglycerides or fat are hydrolysed by an alkali to give glycerol and potassium salts of fatty acids.
- A known quantity of fat or oil is refluxed with an excess amount of alcoholic KOH.

Saponification number

- **How do I find saponification number?**
- Saponification value is a measure of the content of ester linkages.
- It is determined by back titration of potassium oxide in the presence of phenolphthalein indicator with 0.5 N sulfuric or hydrochloric acid.
- First a sample is mixed with 25 ml of alcoholic solution of KOH and left for 1 h in steam bath to react

Saponification number

- **What is high saponification value?**
- The larger the saponification number, the better the soap making ability of the oil.
- Higher saponification value for triglyceride indicates higher medium chain fatty acids.
- Saponification value for unrefined vegetable oils may also be affected by the compounds in the nonsaponifiable fraction.

Saponification number

- **What is saponification example?**
- Saponification is the hydrolysis of an ester under acidic or basic conditions to form an alcohol and the salt of a carboxylic acid.
- Saponification is commonly used to refer to the reaction of a metallic alkali (base) with a fat or oil to form soap.
- Example: Ethanoic acid reacts with alcohols in the presence of a conc.

Saponification number

- **What is the unit of saponification value?**
- Saponification value is expressed by potassium hydroxide in mg required to saponify one (1) gram of fat.
- **What is saponification index?**
- A measure of the total free and combined acids especially in a fat, wax, or resin expressed as the number of milligrams of potassium hydroxide required for the complete saponification of one gram of substance.

Iodine Value

- The iodine value is the number which expresses in grams the quantity of iodine, which is absorbed by 100 g of the substance.
- The iodine value indicates the degree of unsaturation of a fat or oil.
- It is defined as the number of grams of iodine absorbed by 100 g of fat.

Iodine Value

- The higher the iodine value, the less stable the oil and the more vulnerable it is to oxidation and free radical production.
- High iodine value oils are prone to oxidation and polymerization.
- The most important application of the iodine value is to determine the amount of unsaturation contained in fatty acids.
- This unsaturation is in the form of double bonds which react with iodine compounds. The higher the iodine value, the more unsaturated fatty acid bonds are present in a fat.

Iodine Value

- **What is iodine soap value?**
- The Iodine Number indicates the amount of unsaturated fatty acids present.
- Soap made with mostly unsaturated (liquid) fats will tend to have a high Iodine Number and soap made with mostly saturated (solid) fats will have a low Iodine Number.

Iodine Value

- **What is iodine value of fat and oils?**
- Iodine value, also called Iodine Number, in analytical chemistry, measure of the degree of unsaturation of an oil, fat, or wax; the amount of iodine, in grams, that is taken up by 100 grams of the oil, fat, or wax.

Iodine Value

- **Iodine Test:**
- Using **iodine** to **test for** the presence of starch is a common **experiment**.
- A solution of **iodine** (I_2) and potassium **iodide** (KI) in water has a light orange-brown color.
- If it **is** added to a sample that contains starch, such as the bread pictured above, the color changes to a deep blue.

Iodine Value

- **Significance:**
- Iodine numbers are often used to determine the amount of unsaturation in fats, oils and waxes.
- In fatty acids, unsaturation occurs mainly as double bonds which are very reactive towards halogens, the iodine in this case.
- Thus, the higher the iodine value, the more unsaturations are present in the fat.

Acid Value

- The acid value is the number of mg of potassium hydroxide required to neutralize the free acid in 1 g of the substance.
- The acid value (AV) is a common parameter in the specification of fats and oils.
- It is defined as the weight of KOH in mg needed to neutralize the organic acids present in 1g of fat and it is a measure of the free fatty acids (FFA) in a sample of oil or fat indicates hydrolysis of triglycerides.

Acid Value

- acid value - (chemistry) the amount of free acid present in fat as measured by the milligrams of potassium hydroxide needed to neutralize it; "as the glycerides in fat slowly decompose the acid value increases".
- **How do you determine the acidity of oil?**
- The acid value of an oil is determined by titrating a solution of the oil in diethyl ether with an alcoholic solution of sodium or potassium hydroxide.
- It is expressed as the amount of KOH (in mg) to neutralize 1 g of oil.

Difference between acid value and Saponification

- Saponification value reflects the amount of fat present in the biodiesel or the number of fatty acids present in triglycerides,
- whereas the acid value denotes the percentage of free fatty acids (FFA) that are not linked with any other molecules (triglycerides or methyl esters) and remain free as acids in biodiesel.

Acid Value

- Abnormally high levels of free fatty acids are associated with uncontrolled diabetes mellitus and with conditions that involve excessive release of a lipoactive hormone such as epinephrine, norepinephrine, glucagon, thyrotropin, and adrenocorticotropin.

Acetyl Value:

- The number of milligrams of KOH required to neutralize the acetic acid obtained by Saponification of 1 gm. of fat after it has been acetylated.
- This is a measure of the number of hydroxy-acid groups in the fat.
- Or
- The **acetyl value** is the number which expresses in milligrams the amount of potassium hydroxide required to neutralize the acetic acid liberated by the hydrolysis of 1 g of the acetylated substance.

Acetyl Value:

- The number of free hydroxyl groups in a **fat** or **oil**.
- The **acetyl value** is determined by the milligrams of Potassium hydroxide require to neutralize the acetic acid produced when 1 gram of **Fat** or **Oil** is acetylated with Acetic anhydride.

Rancidity

- The term rancid is applied to any fat or oil that develops a disagreeable odor.
- Hydrolysis and oxidation reactions are responsible for causing rancidity.
- Oxidative rancidity occurs in triacylglycerols containing unsaturated fatty acids.

Rancidity

- **Rancidity** is a very general term and in its most general meaning, it refers to the spoilage of a food in such a way that it becomes undesirable (and usually unsafe) for consumption.
- When people say that a food has "gone bad," what they're usually talking about is **rancidity** term rancid is applied to any fat or oil that develops a disagreeable odor.

Rancidity

- Lipid oxidation is one of the major reasons that foods deteriorate and is caused by the reaction of fats and oils with molecular oxygen leading to off-flavours that are generally called rancidity.
- The other cause of rancidity is by a combination of enzymes and moisture.
- **Rancidity** is a condition in which the substance with oil and fats get oxidized when they are exposed to air.
- A substance is said to be **rancid** when there is a change in smell, taste, and colour.
- An **example** of **rancidity** is when a chips pack is exposed to atmospheric air which results in a change in taste and odor.