What is Saponification Value?

The saponification value of an oil or fat (lipids) is defined as the number of mg ofpotassium hydroxide required to neutralize the fatty acids resulting from the complete hydrolysis of 1 g of the sample. A soap is formed during the saponification, for example:

$C3H5(CI7H35COO)3+ 3KOH = C3H5(OH) 3 + 3 CI7H35 \cdot COOK$

The esters of the fatty acids of low molecular weight require the more alkali for saponification, so that the saponification value is inversely proportional to the mean of the molecular weights of the fatty acids in the glycerides present.

The saponification value is of most use for detecting the presence of coconut oil (SV 255), palm-kernel oil (SV 247) and butterfat (SV 225).

Principle:

When a fat is boiled with an excess of alcoholic potassium hydroxide (KOH), the triglycerides hydrolyse, and glycerol and soap are formed. The alkali consumed by this hydrolysis is a measure of the Saponification Value (S.v.). It is defined as the number of milligrams of potassium hydroxide (KOH) required to saponify completely one gram of the oil or fat.

Properties of saponification value

Key properties include an **inverse relationship with molecular weight, indication of fatty acid chain length, and use in purity testing.**

Chain length: Higher saponification value mean shorter fatty acid carbon chains exist in the sample. Lower saponification value point to long carbon chains.

Molecular weight: A high saponification value shows a lower average molecular weight of triglycerides, and a low saponification value shows a higher mean molecular weight.

Factors affecting Saponification Value

The saponification value is mainly affected **by the molecular weight, chain length, and purity of the fat or oil. The key factors are molecular weight/chain length, presence of impurities or adulterants, and oxidative degradation during storage.**

- Molecular Weight and Chain Length

Short carbon chains: Fats with short fatty acid chains have a lower average molecular weight per mole of triglyceride, which means more moles of alkali are needed per gram of fat, resulting in a higher saponification value (e.g., coconut oil is

~250–265).

Long carbon chains: Fats with long carbon chains have a higher molecular weight, requiring fewer milligrams of potassium hydroxide (KOH) per gram of fat, resulting in a lower saponification value.

- Purity and Adulteration

  Adulteration: Mixing a pure oil with a different oil or non-saponifiable matter changes the number of ester bonds per gram, shifting the saponification value outside its standard expected range.

  Contamination: The presence of moisture or unsaponifiable foreign substances lowers the measured saponification value because they do not react with the base (KOH).

  - Storage and Oxidation

  Degradation over time: When oils are exposed to light, heat, and air during storage, triglycerides break down into free fatty acids.

  Rancidity effects: Oxidative degradation increases the concentration of free acids and can alter the overall alkali required during testing, changing the baseline value and indicating oil spoilage.

Difference between acid value and saponification value

Acid value measures the free fatty acids in 1 gram of fat/oil, indicating freshness and rancidity. Saponification value measures the total alkali needed to neutralize free acids and saponify all ester bonds in 1 gram, determining the average molecular weight and chain length of the fatty acids

Iodine value of fat

The iodine value is the mass of iodine in grams that is absorbed by 100 grams of a chemical substance, used to measure the degree of unsaturation (double bonds) in fats and oils.

Measurement: Grams of iodine (I_2) consumed by 100 g of oil or fat.

Indication: Higher value means more double bonds and higher unsaturation.

Application: Evaluates quality, purity, and stability of oils.