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Feeds Forages Mycotoxins Soils Plant Tissues Manure Fertilizers Lime Water

Fats, Oils & Lipids

Iodine Value

Iodine Value (IV) is the grams of iodine absorbed by 100 grams of fat. This value is used to measure the relative degree of unsaturation in fats. Unsaturated fats have higher IV's than saturated fats. The traditional method for this determination is known as the WIJS method. Iodine Value may also be calculated from a fatty acid composition as its value is closely related to the number of double bonds present in the fat.

MIU

MIU is an abbreviation for the tests Moisture, Insoluble Impurities and Unsaponifiable Matter. This value provides information about non-fat/oil components of food and feed grade fats and oils and is used primarily to screen incoming materials for industrial applications.

Moisture

A sample of fat is weighed and the moisture is boiled off. The weight loss is calculated as the moisture content. The recommended moisture level is 1% or less. Moisture can reduce the energy of a fat both by dilution and by causing and increase in the FFA content. Some condensation moisture is unavoidable with any feeding fat, however, it should be kept at a minimum. Moisture at low levels functions much like an antioxidant, but at higher concentrations is a pro-oxidant presumably because if can solublize trace metals (Bailey's Industrial Oil and Fat Products, 4th Edition, P147, Vol. 1). Moisture accumulates in the lower strata of fat storage units which makes sampling difficult. Therefore, prior to sampling fat in storage, it should be thoroughly mixed by mechanical agitation.

Insoluble Impurities

'Impurities' are non-hazardous filterable materials not soluble in petroleum ether. However, impurities can create physical problems as they settle to create tank sludge and ultimately clog valves, lines and nozzles. Impurities could be meat and bone particles remaining in the tallow after the rendering operation even though it is filtered or it could be foreign materials such as sand or metal particles picked up after processing, during storage and/or transport. The same sample that moisture was determined from is filtered through a fine filter paper using a solvent. The weight of the material left on the filter paper is a measure of the insoluble impurities.

Unsaponifiable Matter

'Unsaponifiables', or 'unsaps', refers to any material within the tallow that will not saponify (convert into soap) when mixed with an alkali. This basically covers components of the tallow that are not triglycerides such as plant sterols and pigments. A major portion of the unsap fraction is from plant sterols originating from the gut contents (forages, grains) of rendered offal. The determination of unsap content is based upon saponification followed by extraction with solvents and washing. Unsaponifiables contribute little energy to feeding fat.

Titer

Titer is a measure of the hardness of fat. It is determined by melting the fat and then measuring the congealing temperature in degrees centigrade. The higher the titer value, the harder the fat is at room temperature.

Rancidity

Rancidity in food and feedstuffs may result from oxidation of the lipid component of the sample, microbiological deterioration of the sample or both. Because the lack of a universally accepted definition of rancidity, no single rancidity test will meet every client's needs. Oils are said to become rancid when they undergo a degradation process known as oxidation. A variety of chemical compounds such as peroxides, aldehydes and free fatty acids are created as oil oxidizes. AOM, FFA, PV, & TBA Rancidity are tests most frequently requested to monitor or predict oxidative degradation.

Active Oxygen Method (AOM)

Active Oxygen Method (AOM) is a measure of the ability of a fat to resist oxidative rancidity during storage. An oil or fat is subjected to conditions known to accelerate degradation to help gauge the sample's resistance to oxidation. Oxygen is bubbled into a fat to cause oxidation of the fatty acids. The peroxide value test is used to monitor oxidation after the sample is stressed under controlled conditions for a long time or until a specific peroxide value is achieved.

Active Oxygen Method-20 Hour

The most common test used by the industry to determine fat stability is the 20 hour Active Oxygen Method (A.O.M.) in which a sample of the fat is maintained at 98 DEG C while scrubbed air is bubbled through at a controlled rate. A sample having a peroxide value (P.V.) of 20 meq/kg or less after 20 hours under test conditions is considered acceptable for use in animal feed, while a P.V. of 10 meq/kg or less is considered most desirable. The apparatus and operating conditions for the 20 hour AOM test are generally as described in AOCS Official Method Cd 12-57 (reapproved 1973) entitled "Fat Stability, Active Oxygen Method". According to the AOCS official method, the time in hours required for a sample of fat or oil to attain a certain peroxide value under the specific conditions of the test is determined, and the length of that period is taken as an index of resistance to rancidity.

Free Fatty Acids (FFA)

Free Fatty Acids (FFA) Fats and oils are primarily composed of various combinations of fatty acids bonded to a glycerine backbone. When fats and oils become rancid, individual fatty acids are "freed" and make the material slightly acidic. The FFA test measures this acidity and then expresses it on a fatty acid basis. The presence of high concentrations of free fatty acids in feed-grade fat, particularly "whole" animal fats may mean the fat is rancid. However, some fat sources such as acidulated soap stocks, can contain high amounts of free fatty acids without being rancid.

Peroxide Value

Peroxide Value (PV) is the measure of the present state of rancidity of a sample. Also called Initial Peroxide Value (IPV) because it is determined on a sample as submitted. Fresh non-rancid fats have a low PV - usually less than 5. The PV of unstablized fat can change quickly. For this test, peroxides are indirectly measured under standardized conditions. The result is called the Peroxide Value, expressed as milliequivalents of peroxide per kilogram of fat.

TBA Rancidity

TBA Rancidity monitors certain types of aldehydes that form when a fat or oil oxidizes. These aldehydes react with 2-Thiobarbituric Acid (TBA) in the laboratory to form a complex that is easily measured.

p-Anisidine

p-Anisidine or Anisidine Value is a measure of aldehydes in oil that is not dependent on oxygen. Oils that have been substantially oxidized can yield a low peroxide value if they hae been heated in the absence of oxygen. The p-Anisidine test is therefore useful for abused oils with low PV's.

Fatty Acid Profile

The fat is saponified and then methyl esters are formed. These methyl esters of the component fatty acids are then injected onto a gas chromatograph column and the fatty acids are separated due their differing solubility in the liquid phase of the column. The fatty acids elute from the column and are burnt in a hydrogen flame. The increased electric activity generated by the incineration is recorded and the percent fatty composition of the fat is calculated. With the development of column technology, the fatty acid composition can be determined within 20 minutes of the sample being taken.

Total Fatty Acids

Fat quality is determined by energy value, stability, and freedom from extraneous materials. Total fatty acids (TFAs) are comprised of both free fatty acids and those combined with glycerol (intact glycerides). Fat is composed of approximately 90 percent fatty acids and 10 percent glycerol. Glycerol contains about 4.32 calories per gram compared with 9.40 calories per gram for fatty acids. Since fatty acids contain over twice the energy of glycerol and are the primary energy source in feeding fats, the TFA content acts as one indicator of the energy. TFA levels less than 90 percent reflect dilutions with other ingredients and the value should be discounted on total fatty acid content.

Saponification Value

This is an estimate of the mean molecular weight of the constituent fatty acids in a fat sample and is defined as the number of milligrams of potassium hydroxide required to saponify one gram of fat. The higher the saponification value, the lower the mean chain length of the triglycerides.

Polyethylene

Almost all tallow contains PE to some degree. PE is a foreign material in tallow. It finds its way into the rendering plant as meat wrappers mixed in with the raw material. Most of the polyethylene wrappers used by the meat industry are of low density type that will melt at lower temperatures and stay soluble in the tallow.
At present the only feasible means of removing PE from tallow is to filter the tallow at low temperature using special filter aids. Most tallow consumers say they could stand up to 30ppm while others feel they could take as high as 200ppm. The problem with PE is that it does not stay soluble in all the various stages of the manufacturing process. In particular if there is a sharp temperature drop the PE will come out of solution, with soap manufacturers it has been known to adhere to the inside wall of pipes and after it builds up darkened pieces flake off which later show up in the finished bar soap. It has also been known to cause blockage in fatty acid manufacturing plants and can coat the catalyst.

Rate of Filtration

This method was originated by Proctor and Gamble to ensure themselves of clean tallow. Fats which will give processing difficulties such as slow filtration, emulsions, and foaming can be detected by this filtration method. The method is based on the amount of fat that will filter in a specified time under standard conditions.
The results from this test could run 40, which means 40 milliliters of tallow at 230oF (110oC) passed through the filter paper in five minutes. Proctor and Gamble likes to purchase tallow with 35-40 ROF. (Filter paper is VWR international Grade 417) Microscopic fines, polyethylene and plant gums from the raw material could cause a slow filtration by plugging the pores of the filter paper thus resulting in a very low ROF. Tallows that have been water washed or prefiltered will generally run a high ROF due to removal of fines and gum.

Boehmer Number

This test is used to determine if tallow is mixed with lard. For pure lard, the number should be greater than 73. If less than 73, it indicates contamination.

Lead (heavy metal):

The U.S. Food and Drug Administration tolerance for lead is 7 ppm. Lead is considered to be a toxic substance in concentrations greater than this tolerance. The methods of analysis are by atomic absorption, inductive-coupled plasma analysis or by ultra-violet spectrophotometry.

Color Tests (Lovibond, FAC)

'FAC' is the abbreviation for the Fat Analysis Committee of the AOCS. A sample of fat is filtered then compared with standard color slides mounted on a circular aperture. FAC color standard runs from 1-45 using odd numbers divided into five series for grading:

1-9	=	light colored fats
11, 11A, 11B, 11C	=	very yellow fats
13-19	=	dark, reddish fats
21-29	=	greenish fats
31-45	=	very dark fats

The different series are somewhat independent so there is no orderly increase in the color from the lowest to the highest numbers, i.e., fats graded 21-29 may actually be lighter than those graded 13-19. The FAC method is used when fats are too dark or green to be read by the Lovibond method.

Many customers require low FFA and color so that they can maximize the yield of products they manufacture from tallow. A low FFA results in a high glycerin yield for the soap manufacturer. Similarly a low color tallow enables the manufacturer to produce high quality white bath soap or high quality fatty acids. 'R&B' means refined and bleached. This analysis determines the Lovibond color of the sample after treatment with alkali and a specified bleaching earth. The Lovibond color is a much finer color reading compared to the FAC color standards. The color is 20 reported as Red and Yellow. For example, a good Extra Fancy tallow will read 0.5 Red and five Yellow. In reading tallow, the Yellow is 10 times the red (0.5 x 10 = five Yellow).

Flash Point

The flash point of a volatile material is the lowest temperature at which it can vaporize to form an ignitable mixture in air. Measuring a flash point requires an ignition source. At the flash point, the vapor may cease to burn when the source of ignition is removed.

Melting Point, Capillary Solid Fat Index

The melting point of a solid is the temperature at which it changes state from solid to liquid. At the melting point the solid and liquid phase exist in equilibrium. The melting point of a substance depends (usually slightly) on pressure and is usually specified at standard pressure. When considered as the temperature of the reverse change from liquid to solid, it is referred to as the freezing point or crystallization point.

Smoke Point

The smoke point of an oil or fat is the temperature at which it begins to break down to glycerol and free fatty acids, and produce bluish smoke. The glycerol is then further broken down to acrolein which is a component of the smoke. It is the presence of the acrolein that causes the smoke to be extremely irritating to the eyes and throat. The smoke point also marks the beginning of both flavor and nutritional degradation. Therefore, it is a key consideration when selecting a fat for frying, with the smoke point of the specific oil dictating its maximum usable temperature and therefore its possible applications. For instance, since deep frying is a very high temperature process, it requires a fat with a high smoke point.

Solid Fat Index

Solid fat index (SFI) is a measure of the percentage of fat in crystalline (solid) phase to total fat (the remainder being in liquid phase) across a temperature gradient. The SFI of a fat is measured using a dilatometer that measures the expansion of a fat as it is heated; density measurements are taken at a series of standardized temperature check points. The resulting SFI/temperature curve is related to melting qualities and flavor. For example, butter has a sharp SFI curve, indicating that it melts quickly and that it releases flavor quickly.