



<b>Term</b>	<b>Definition</b>
Acid Hydrolysis	results in a reduction in the average molecular size of the starch molecules. Acid-thinned starch pastes tend to have a lower hot viscosity than native starch and a strong tendency to get when cooled.
Acid Stability	The stability of a starch to an acidic low pH environment. It is determined by monitoring the change in the starches properties under defined conditions of storage.
Acid-thinned Starch	Acid-thinned starch is usually prepared by the treatment of an aqueous starch suspension with dilute acid at a temperature below the gelatinization point. The granular form of the starch is maintained.
Agglomerate	a process in which the surface of small particles of dry starch is wetted with water and "stuck together" during another drying process to form larger particles. This improves the dispersion or solubility in a food system to produce a "lump-free" product such as an instant pudding or gravy.
Amylopectin	a very large, branched polymer of glucose (dextrose) which makes up part of all of the starch granule. It is composed of anhydroglucose units with the linear portions linked alpha 1,4 and the branch points linked alpha 1,6.
Amylose	a linear polymer smaller than amylopectin which is sometimes present in the starch granule. It is composed of anhydroglucose units linked alpha 1,4. This polymer forms a gel when starch is cooked and subsequently cooled.
Aseptic	Ultra high temperature cooking of a food before it is deposited in a sterile container. This process assures sterility in the food product.
Birefringence	When starch granules are viewed under the microscope by polarized light they exhibit a phenomenon known as birefringence - the refraction of polarized light by the intact crystalline regions to give a characteristic "Maltese cross" pattern on each granule. The disappearance of these crosses on heating a starch suspension is used to determine gelatinization temperature.
Bleached Starch	Starch that has been treated with low levels of oxidant to improve whiteness without materially affecting other key properties such as viscosity.
Bostwick Viscometer	a device to determine the viscosity of a product by determining the amount of flow a product shows during a given amount of time. The product is placed in a try behind a trap door. The door is released and the product is allowed to flow freely for a defined amount of time. The distance traveled is defined as the Bostwick viscosity.
Brabender Viscosity	Brabender is the name of the manufacturer [Duisburg, Germany] of the Brabender Amylograph or Viscograph, which was the starch industry's established method for determining the viscosity characteristics of starch as it gelatinizes in water. The instrument is a rotational viscometer that allowed the continuous determination of viscosity as the initial suspension of granular starch is heated, gelatinized to a paste, then cooled under closely controlled conditions. Starch concentration, heating/cooling rates and holding periods at defined temperatures can be varied. The Brabender viscosity of a starch is not an absolute quantity; different instruments can give different results even under the "same" test conditions.

Brookfield Viscometer	The Brookfield Synchro-lectric Viscometer is a portable rotatory instrument where a rotating cylinder or disc known as the "spindle" is immersed in a test liquid and rotated by a synchronous motor. Apparent viscosity is calculated from the scale reading by use of factors that depend on spindle number (size) and rotation speed.
Bulk Density	The apparent density of a powder or particulate product. It is the weight of a unit volume of the powder including the pores and inter-particle voids. The bulk density may be determined on the loose unpacked powder and on the powder after tamping ('packaging') under defined conditions.
Carbohydrate	A chemical compound containing on the elements Carbon, Hydrogen and Oxygen. Cellulose, starch, sugars and polyols are typical examples. All carbohydrates contribute approximately 4Kcal/gram.
Chemically-modified Starch	A starch which has been treated with chemicals so that some hydroxyl groups have been replaced by (usually) ester or ether groups. Crosslinking, in which two hydroxyl groups on neighboring starch molecules are linked chemically, is also a form of chemical modification. Every very low levels of chemical modification can fundamentally change the rheological-, physical-, and chemical properties of starch.
Citric Acid	An odorless, colorless naturally occurring organic acid with the empirical formula $C_6H_8O_7$ in the anhydrous form. Citric acid widely distributed in plants and animals and plays a key role in fundamental metabolic processes such as the oxidative breakdown of dietary proteins, carbohydrates and fats.
Citric Acid (anhydrous)	This grade of citric acid with less than 0.5% moisture and is 99.5% (minimum) pure.
Citric Acid (monohydrate)	The moisture content of the Citric Acid monohydrate is 8.8% (maximum) but this may change on storage due to efflorescence.
Cold Water Soluble Starch	This term is often used to denote pregelatinized, cold water swelling, or cold water dispersible starches.
Cook-ups	starches that must be cooked to provide viscosity or thickening for a food system.
Crosslinked Starch	Starch which has been treated with a bi- or polyfunctional reagent by the manufacturer so that a small number of the starch polymer chains are chemically linked by the cross linking reagent moiety. Crosslinking partially inhibits granule swelling on gelatinization and gives increased stability to acid environments, heat treatment, and shear forces. Extremely low levels of crosslinking are effective in achieving these objectives. Crosslinking is widely used to prepare chemically-modified starches for the processed food industry. the linking together of starch chains using a chemical reagent.
Crosslinking	This strengthens the granule and reduces both the rate and the degree of granule swelling and subsequent disintegration. Thus, crosslinked starches are less sensitive to processing conditions than native starch granules.
Degree of polymerisation [DP]	The degree of polymerization of a polymer is the average number of monomer units in the molecule. It refers to the average number of anhydroglucose units in the molecule. The abbreviations DP1, DP2 etc. refer to polymer chains where the number of anhydroglucose units is known. Abbreviations such as DP 3+ are used to denote all unknown degrees of polymerisation of 3 and above. The abbreviation Dpn is used to denote a fraction with an unknown degree of polymerization.
Dextrin	Dextrins are starch hydrolysis products obtained in a dry roasting process either using starch alone or with trace levels of acid catalyst. These products have a good film forming and adhesive properties. They are used by the food industry as coatings in the adhesive toppings and in batters and breadings.

Dextrinization	a chemical modification process in which dry starch is heated in the presence of acid to produce products with higher solubility, lower viscosity and better stability than native starches. Products of this process are called dextrins.
Dextrose	D-glucose obtained by the complete hydrolysis of starch, followed by purification and crystallization. Dextrose can be obtained as the anhydrous or monohydrate form. The monohydrate contains one molecule of water per molecule of D-glucose.
Dextrose Equivalent	The reducing power of a starch hydrolysis product expressed as a % of the reducing power of the same weight of D-glucose. The higher the D.E., the lower the number average molecular weight of the product. The maximum possible D.E. is 100 (i.e. pure dextrose).
Drum-dried Starch	Also known as roll-dried starch. Pregelatinized starch made by cooking and drying a starch paste on steam-heated rolls. A starch slurry or paste is deposited in a thin layer on rotating heated drums or rolls. The dried film is removed with a scraper then the product is ground in a mill to the desired particle size. Chemicals may be added before, during, or after drum drying.
Dusting Starch	Starch powder that is applied to substrate in order to reduce or eliminate adhesion to other substrates.
Enzymatic Hydrolysis	This term refers to the depolymerization of starch under the action of an amylase enzyme. Enzymatic reactions have the advantage of producing highly specific distributions of glucose sugars and oligomers; they have largely superseded acid hydrolysis in the manufacture of glucose syrups and other starch hydrolysates.
Enzyme	A enzyme is one of a group of complex chemical substances produced by living organisms [e.g. bacteria, fungi] that promote and catalyse high specific chemical reactions. The breaking of the chemical bonds in starch by amylase enzymes is an example.
Flash Dryer	Dryer with very fast drying action where the wet material is conveyed by the flow of hot drying air. Frequently used to dry starch.
Freeze-thaw Stability	The ability of a starch paste or food composition containing starch to maintain its integrity without syneresis of water when subjected to repeated thermal cycling between ambient and freezing temperatures. Freeze-thaw stability is imparted to starches substitution. Hydroxypropyl starches are particularly suitable for food applications requiring freeze-thaw stability.
Gel	The semi-rigid jelly-like sol that is formed when cooked starch paste is cooled and stored at room temperature. It is usually associated with native starches and acid-thinned starches.
Gelatinization	The destruction of molecular order and irreversible swelling of starch granules under the influence of heat and/or chemicals in an aqueous medium to give a starch paste. During the swelling process amylose tends to leach out of the starch granules and, with amylopectin, becomes hydrated. Viscosity rises and is at a peak when the granules are hydrated to their maximum extent and are in close contact with their neighbors. The granules then rupture, collapse and fragment. Polymer molecules and aggregates are released into the surrounding aqueous medium. Gelatinization is, in fact, a multi-step process from the first incipient granule swelling through to complete granule disruption and partial solubilization of the constituent polymers.

Gelatinization Temperature	The temperature at which a particular starch gelatinizes to form a starch paste. This depends on starch type, the chemical environment, and several other factors. Values quoted in literature should be taken as approximate because starch gelatinizes over a finite temperature range which can be determined by viscometry, on a microscope hot stage, by observing granule crystallinity under polarized light etc etc. Each technique gives different values. Gelatinization temperature of starches can be changed by physical or chemical pretreatments. Pasting temperature and chemical gelatinization are related concepts.
Gelling	It is used more precisely to denote the conversion of starch paste, on storage and/or cooling, from a fluid paste to a semi-solid deformable gel structure. Gelling occurs as the hydrated and dissolved linear amylose molecules in a starch paste associate to form a three dimensional network.
Glucose	A sugar with the molecular formula C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> . It is produced commercially by the first liquefying starch to an intermediate Dextrose Equivalent then continuing the hydrolysis by saccharification with glucoamylase. Glucose (also known as Dextrose) may be crystallized from high dextrose syrup as the monohydrate.
Glucose Syrup	Known as corn syrup in USA. Purified concentrated aqueous solution of nutritive saccharides made from starch and having a dextrose equivalent above 20.
Granular Instant Starch	When starch is heated in the presence of limited moisture and an organic solvent, e.g. in aqueous alcohol, the internal crystalline structural order is destroyed but the granule shape and integrity are maintained. When such a starch is dispersed in cold or warm water, swelling occurs followed by viscosity development. Granular Instant Starches have higher and more stable viscosities than conventional pregelatinized starches.
Granule (as in starch granule)	Starch exists in certain plant species in the form of small particles known as granules. These granules have a characteristic size and shape depending on the particular species involved. Microscopic examination may be used to identify starch type by reference to standard images of different starch granule types.
GRAS - Generally Recognizes as Safe	A classification of foods and food ingredients by the Food and Drug Administration in the USA.
Heat Stability	The stability of a particular product property when the product is exposed to long or short term storage under hot conditions. Examples include the viscosity of starch paste or the color of glucose syrup.
High Amylose Starch	A genetic variety of starch containing over 50% amylose. Current commercial varieties contain 55%, 70% and 80% amylose. High amylose starch is highly crystalline and requires special techniques to achieve full gelatinization.
High Fructose Corn Syrup (HFCS)	A special type of glucose syrup containing high levels of fructose. HFCS is produced by enzymatic conversion of starch to glucose followed by conversion of some of the dextrose to fructose using the enzyme isomerase.
Humectancy	Ability of a substance to hold into moisture. Increased humectancy prevents staling in baked products and provides foods with soft, moist eating quality.
Hydration	the process of the starch granule taking up and binding water as it swells when heated in water.
Hydrogenation	The chemical transformation of reducing sugars into the analagous polyol. For example transforming dextrose into sorbitol.

Hydrophobic Starch	Starch which has been chemically modified to give a hydrophobic character. An example is the ester starch n-Octenyl Succinate made by treating starch with n-Octenyl Succinic anhydride. This is used as a food starch e.g. for emulsion stabilization.
Hygroscopicity	Ability of a substance to absorb and react with moisture from ambient air.
Instantize	a physical starch modification process that produces pre-gelatinized and cold water swelling or granular starches. Instant starches when mixed with water or other liquids develop viscosity "instantly" or within minutes without heating or cooking. Examples of foods containing instant starches are instant pudding and sauce mixes.
Lipophilic	having a strong affinity for fats and oils. Lipophilic starches are used, for example, to encapsulate flavor oils and emulsify beverage flavors.
Long (texture)	The textural attribute of a food product that exhibits stringiness. Examples include cheese sauce, syrups and certain pourable salad dressings.
Maltodextrins	hydrolyzed starch products that are partially or completely soluble. They are less hydrolyzed or have higher molecular weights than corn (glucose) syrups and are more viscous. Maltodextrins are good flavor carriers and are used to provide "mouthfeel" and viscosity for many foods and beverages. Maltodextrins are classified as having a dextrose equivalent of less than 20.
Moisture Content	The moisture content at which commercial starches are sold is related to the natural equilibrium moisture content of the particular starch. For example cornstarch is usually supplied at 11% - 13% moisture whereas potato starch has 18% - 20% moisture. Specially-dried starches are available to meet specific requirements with moisture contents below these levels however special storage conditions and packaging are needed to avoid moisture pick-up from the atmosphere.
Molding Starch	Starch, usually with low levels of added oil, which is applied by spraying. This starch has deliberately-induced poor flow properties and therefore retains an impression. It is used as depositing medium for molded candies and gum confectionary. White mineral oil was originally used to prepare molding starch and the mineral oil-based product continues to be available. Vegetable oil-based molding starches were developed and are also available commercially.
Mouthfeel	The textures and sensory attributes exhibited within the mouth upon eating. Although subjective, mouthfeel characteristics greatly impact consumer acceptability of a food product.
Native Starch	Starch recovered in the original form (i.e. unmodified by extraction from any starch-bearing material. Often used to distinguish native unmodified starch that has undergone physical or chemical modification.
Organoleptic Properties	Those properties of a foodstuff or food ingredient that are perceived in the mouth during consumption. The properties include taste, mouthfeel, consistency, texture, chewability, stickiness etc. etc. Ideally the starch component of a food formulation should contribute no flavor at all; this is not its function. Crosslinking has a profound effect on starch paste texture; crosslinked starches generally have a short stringless consistency. Sweetness is the predominant organoleptic property of glucose syrups.
Oxidation	a chemical starch modification process. Oxidation whitens or bleaches the starch, lowers the viscosity, provides viscosity stability by minimizing retrogradation of dent starches, reduces microbial load and improves adhesive properties. Slightly oxidized starches are used by the food industry in batters and breadings, retort applications and tableting.
Particle Size	Usually expressed as a particle size distribution giving the full range particle sizes found in the sample. Particle size of soluble products recovered from solution by drying e.g. maltodextrins, or by crystallization e.g. dextrose are determined by dry sieve methods.

Pasting Temperature	The temperature at which the viscosity curve produced in the Brabender viscograph leaves the baseline as the temperature rises during the initial heating process.
Peak Viscosity	The highest viscosity reached during gelatinization of starch usually corresponding to the point where all the granules are swollen to occupy a high proportion of the available volume with each in contact with its immediate neighbors. May be conveniently observed on the Brabender Viscograph. Note that on cooling the starch paste, the viscosity may rise above this level, but only the initial shoulder (Cornstarch) or true peak (Potato starch) values determined on the hot paste are termed peak viscosity.
pH	The negative logarithm to the base 10 of the hydrogen ion concentration in solution. Universally used as a scale [from 0 to 14] as a measure of acidity [which increases from pH7 to pH0], and of alkalinity [which increases pH7 to pH 14]. pH7 represents the negative logarithm of the hydrogen ion concentration in pure water i.e. neutrality.
Physically-modified Starch	Starch which has been physically treated by the manufacturer without the introduction of new chemical groupings. Examples of physical modification include roll-drying, extrusion, spray drying, heat/moisture treatment etc.
Pituitous	An undesirable textural attribute characterized by a long, stringy, snotty, discontinuous appearance usually caused by overcooked starch. An example would be uncooked egg whites.
Polydextrose	a randomly branched anhydroglucose polymer made by heating glucose in the presence of acid and sorbitol. It is poorly digested because of its structure and, therefore, it has a caloric value of 1Kcal/gm compared to starch of 4Kcal/gm. It is used to replace nutritive sweeteners and sometimes fats in reduce calorie, low calorie, and sugar-free foods.
Potato Starch	Starch from potatoes. Potato starch granules are large, extending up to about 100 u in diameter. This starch has a low gelatinization temperature and is quite sensitive to alkalis. It is a highly swellable starch giving a pronounced viscosity peak. Potato starch pastes are more resistant to retrogradation than those of corn starch.
Powdered Starch	Commercial starch that has been milled and pre-sifted so that it passes through a sieve of specified size.
Pre-gelatinized Starches	these are instant starches that are precooked and dried by the starch manufacturer. A roll dryer is commonly used for cooking and drying. These starches are used, for example, in instant dry mixes. They exhibit a grainier texture than cold water swelling or granular instant starches in these products.
Retort	A process in which a food product is sealed in a container and subjected to very high temperatures to ensure acceptable sterilization. Retorted products are typically sealed in cans.
Retrogradation	Gradual irreversible insolubilization of starch paste with formation of a precipitate or gel depending on concentration. Also known as "set back". Retrogradation is mainly due to the presence of amylose in the starch. The linear amylose molecules are attached to each other and form bundles of parallel polysaccharide chains by the formation of hydrogen bonds between hydroxyl groups on neighboring molecules. Amylopectin having a branched structure shows little tendency to retrograde.
Rheology	The study of deformation and flow of materials. This provides scientific basis for subjective measurements such as mouthfeel, spreadability and pourability.
RVA	Rapid Viscro Analyzer - A quick method to determine the viscosity of a starch slurry over a range of temperatures, times and shear rates.

Salve (Gel)	Three-dimensional network of polymer that traps water, forming a semi-solid system.
Set Back	Used as a synonym for retrogradation to describe the rise in paste viscosity as a starch paste cools.
Shear	Lateral stress applied to one of the faces of a body. Encountered during the mixture of foods, shear can physically destroy a starch granule leading to loss of viscosity and undesirable textural changes. Examples of sources of shear are pumps and mixers.
Shelf Life Stability	Shelf life stability is defined as the maintenance of the original properties of a product as the product is stored for appropriate periods of time in varying conditions of temperature, relative humidity, incident sunlight etc. The properties to be maintained may include colour, viscosity, taste, texture, acidity, freedom from syneresis etc. A number of factors should be taken into account including high/low temperature storage, pH, flavor stability, migration of moisture and/or oil in the formulation, and finally microorganism activity and the potential for bacterial spoilage on prolonged storage under unsuitable conditions.
Short Texture	The texture of a liquid composition is referred to as being "short" when it is cohesive and free from strining. It will not form filaments or threads during application. Starch gels prepared from highly crosslinked starches typically exhibit short texture. Short cuttable textures are associated with increased amylose levels in starch. Some high amylose starch hybrids have been proposed for quick setting confectionary applications which exploit the rapid setting and short texture require in these products.
Sorbitol	D-sorbitol occurs widely in nature and is found in apples, peaches, pears, and plums. It is produced industrially by the catalytic hydrogenation of D-glucose that has been obtained by enzymatic hydrolysis of starch. Its relative sweetness compared to sucrose is between 50 and 60.
Starch	A carbohydrate polymer occurring in granular form in the organs of certain plant species notably cereals, tubers, and pulses such as corn, wheat, rice, tapioca, potato, pea etc. The polymer consists almost exclusively of linked anhydro-cx-D-glucose units. It may have either a mainly linear structure [amylose] or a branched structure [amylopectin]. A single plant species may exist as hybrids with various proportions of amylose and amylopectin e.g. high amylose corn. The molecular weight of the constituent polymers, particularly amylose, varies between different starch sources. All starches form more or less viscous pastes when cooked in water but there are significant differences in paste texture, viscosity and stability.
Starch Derivatives	Generic term for all products produced from native starch including modified starches and starch hydrolysis products.
Starch Gel	An elastic deformable mass formed from an aqueous dispersion of gelatinized starch. A starch gel has visco-elastic properties.
Starch Hydrolysate	Product obtained by the acid- and/or enzymatic hydrolysis of starch consisting of a mixture of low molecular weight polysaccharides, oligosaccharides and simple sugars.
Starch Paste	The viscous colloidal mass resulting from the gelatinization of starch in water. Starch paste is not a solution but contains swollen granule remnants, dissolved amylose, and a number of intermediate species. The stability of starch pastes depends on starch type (amylose/amylopectin ratio), concentration and storage temperature among other factors.
Starch Slurry	Aqueous suspension of unswollen starch granules. Synonyms are starch suspension and starch milk.

Substitution	a chemical starch modification process. Chemical groups such as hydroxypropyl, acetyl, and octenyl succinyl groups are added to the starch molecule. These provide improved functional properties such as improved freeze/thaw stability, viscosity stability, and higher water holding capacity.
Sweetness	Relative sweetness is the level of perceived sweetness compared to that of pure sucrose assessed under the same conditions.
Syneresis	The separation of water or fluid that disassociates or exudes from starch products or jelly due to concentration and shrinkage of a gel, which squeezes out the dispersing medium. Occurs in overcooked custard, for example.
Tabulating Starch	Corn starch has been used for years as a tabulating binder. The granules partially fuse together under the influence of the high compression forces of the tabulating machine to provide a strong tablet that is resistant to breakage in transport but with well-defined disintegration properties after ingestion.
Tapioca Starch	Synonyms: manioc- and cassava starch. Tapioca starch is obtained commercially by wet milling the tuberous roots of these species. It is produced mainly in South-East Asia and is often chemically modified e.g. crosslinked and hydroxypropylated for food applications.
Texture	The texture of a starch paste is a function of the starch type and the presence of any physical or chemical modification. The range of texture may extend from short and cohesive which is characteristic of a crosslinked starch, or long, tacky and fluid which is typical for native potato starch pastes.
Thin-boiling Starch	A modified starch which gives a lower viscosity paste than unmodified starch at the same concentration in water. Also known as acid-thinned starch.
Thinning	the reduction in molecular weight and, therefore, the viscosity of a starch using acid and/or enzymes. This process is used to produce thinned starches, maltodextrins, and corn syrups.
Viscometer	An apparatus or instrument designed for the measurement of the apparent viscosity of fluids.
Viscosity	A term used to denote the resistance of liquids to shear, agitation or flow. Viscosity is defined as the tangential force, which a fluid flowing in one plane exerts on an adjacent plane. A thick solution has more viscosity than a thin solution.
Water Activity	The ratio of the water vapor pressure of a product to the saturation pressure of water at the same temperature. Water activity of foodstuffs is important in determining their physical structure, handling characteristics, palatability, digestibility, and shelf life.
Waxy Starch	Starch containing approximately 100% amylopectin which is obtained from certain plant sources such as corn, rice. According to the starch source the terms waxy maize starch, waxy rice starch may be used. Waxy starches are generally chemically modified to improve heat-, acid-, shear-, and freeze/thaw stability for use in food applications.