

World's Leading Hydrocolloid
Solutions Provider



KELCOGEL® gellan gum
Book



KELCOGEL[®] Gellan Gum



CP Kelco ApS was formed in 2000 by the combination of the Copenhagen Pectin/Food Gums Division of Hercules Incorporated and the Kelco Biopolymers business of Monsanto Company.

CP Kelco is the global leader in the hydrocolloids (thickeners and stabilizers) market, with leading positions in xanthan gum and pectin, and a strong position in carrageenan. The company has more than 2,000 customers in over 100 countries and facilities in North America, Europe, Asia, and Latin America.

CP Kelco manufactures and sells a broad spectrum of texturizing and stabilizing ingredients to the world's processed food and industrial markets. Our products are used in applications as diverse as jams, jellies, processed meats and salad dressings, household cleaners, air freshener gels, toothpaste, personal care products, and pharmaceuticals.

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Table of Contents

INTRODUCTION	3
ORIGIN AND PRODUCTION	4
MOLECULAR STRUCTURE	4
SOLUTION PREPARATION	5
GEL FORMATION	6
GEL TEXTURE	7
FACTORS EFFECTING GEL TEXTURE	8
Effect of Cations	8
Effect of Acids	8
Effect of Sugars	9
Other factors	10
BLENDS OF LOW ACYL AND HIGH ACYL GELLAN GUM	11
THERMO-REVERSIBLE GELS	12
DEGRADATION DURING GEL PREPARATION	12
FLUID GELS	13
COMPATIBILITY	14
Surfactants	14
Acid/Base Compatibility	14
GELLAN GUM PRODUCTS	15
APPLICATIONS	16
Food Applications	16
Gelled products	17
Fruit-based products	17
Starch-based products	17
High solids products	18
Beverages	19
Dairy foods	20
Farinaceous foods	20
Asiatic foods	20
Emulsions	21
Films and coatings	21
Adhesion systems	21
Other Applications	22
Microbial	22
Plant tissue culture	22
Air fresheners	22
Paper	22
Pharmaceutical	23
Personal care	23
Oral care	24
REGULATORY STATUS	25
RESEARCH AND DEVELOPMENT	26
MANUFACTURING	27
BIBLIOGRAPHY	28



KELCOGEL[®] Gellan Gum

Introduction

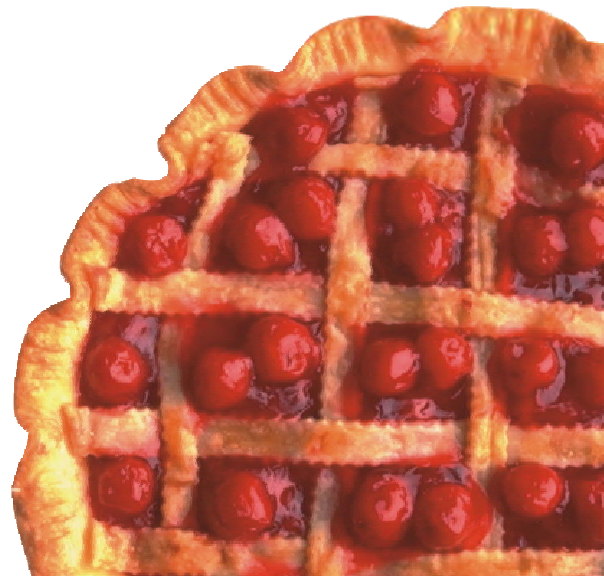
Gellan gum is an effective and useful gelling agent for foods because it:

- is effective at very low concentrations, ensuring no flavor masking
- gels on cooling
- is manufactured by fermentation, so its quality is consistent and supply is reliable
- gives a wide range of textures from brittle to elastic

KELCOGEL[®] gellan gum products are available in two forms (high and low acyl content), which may be blended to give just the right product properties. They may also be used with advantage in combination with other gelling agents.

In order to help customers maximize the benefits of using gellan gum, CP Kelco provides a high level of support and technical service.

We are ready to work with individual companies to provide exactly what they need. When you are looking for an ingredients supplier, that can keep you ahead of the field, there's really only one choice – **CP Kelco**.





KELCOGEL[®] Gellan Gum

KELCOGEL[®] Gellan Gum – What is it?

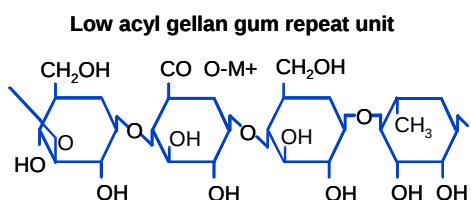
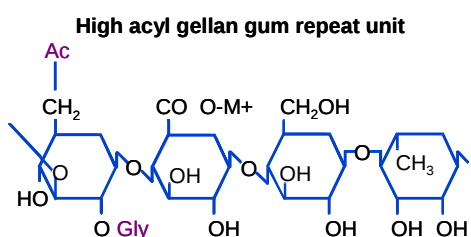
KELCOGEL[®] gellan gum is a hydrocolloid produced by the microorganism *Spingomonas elodea*. This organism was found during an extensive screening program seeking naturally occurring hydrocolloids with useful properties.

Gellan gum is manufactured by fermentation of a readily available carbohydrate raw material. Deacylation is carried out by treating with alkali. Gellan gum is available commercially as a free-flowing white powder.

Comparison of Physical Properties of High Acyl and Low Acyl Gellan Gum⁽¹⁾

	KELCOGEL[®] LT100 (High Acyl)	KELCOGEL[®] (Low Acyl)
Molecular Weight	1 - 2x10 ⁶ Daltons	2 - 3x10 ⁵ Daltons ⁽²⁾
Solubility	Hot water	Hot or cold water
Set Temperature	70° - 80°C (158° - 176°F)	30° - 50°C (86° - 122°F)
Thermoreversibility	Thermo-reversible	Heat stable

Gellan Gum Structure



Ac = acetate group

Gly = glycerate group

The molecular structure of gellan gum is a straight chain based on repeating glucose, rhamnose, and glucuronic acid units^(3,4). In its native or high acyl form, two acyl substituents – acetate and glycerate – are present. Both substituents are located on the same glucose residue, and on average, there is one glycerate per repeat and one acetate per every two repeats⁽⁵⁾. In low acyl gellan gum, the acyl groups are removed completely. The acyl groups have a profound influence on gel characteristics. The high acyl form produces soft, elastic, non-brittle gels, whereas the low acyl form produces firm, non-elastic, brittle gels.



KELCOGEL[®] Gellan Gum

Solution Preparation

The hydration temperature of low acyl gellan gum is very sensitive to the ionic environment and particularly sensitive to divalent ions. Low acyl gellan gum is a mixed salt and will only partially hydrate in cold deionized water. Gum hydration is further inhibited by the divalent ions in most water supplies. This inhibition makes low acyl gellan gum easy to disperse in cold water without forming lumps. Subsequently, the gum can be hydrated using sequestrants, heat or a combination of both.

Calcium sequestrants, such as citrates and phosphates, can be used to control the divalent ions. Therefore, the hydration temperature of low acyl gellan gum can be effectively controlled. Without sequestrants, low acyl gellan gum requires a temperature of 75°C (167°F) to fully hydrate the gum. However, low acyl gellan gum can be hydrated in cold soft water using 0.3% sodium citrate, as seen in the chart below.

The setting temperature, melting temperature and final gel strength of low acyl gellan gum are also affected by cations and, therefore, sequestrants. Control of low acyl gellan gum properties can be achieved by balancing sequestrants, pH and added ions.

High acyl gellan gum will swell in deionized water creating a starch-like consistency. This swelling behavior can be inhibited by low levels of sodium. The use of sodium to inhibit swelling is a useful strategy for improving gum dispersion and for minimizing viscosity during processing. Heat is required to fully hydrate high acyl gellan gum. While ions affect

dispersion and particle swelling behavior, the hydration temperature of high acyl gellan gum is relatively insensitive to ions. High acyl gellan gum hydrates between 70°C and 80°C (158°F and 176°F) even in relatively high ion concentrations.

Both forms of gellan gum can be dispersed directly in milk will hydrate during normal heat processing without sequestrants.

Gum hydration is inhibited by soluble solids and low pH for both forms of gellan gum. In high solids systems, extra care must be taken to ensure that the gellan gum hydrates. In acidic environments, the pH must be above 4 for good hydration.

**Hydration Temperatures of
0.25% Gellan Gum Solutions**

Water Hardness (ppm CaCO ₃)	Added Sodium Citrate (%)	Hydration Temperature (°C)	
		Low Acyl	High Acyl
0	0	75	71
100	0	88	73
200	0	>100	75
200	0.3	24	70
400	0.3	35	70



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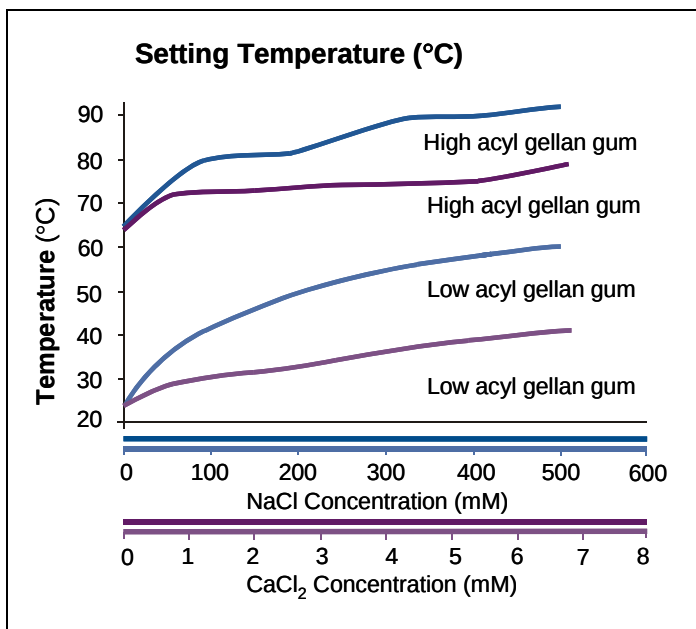
Gel Formation

Gellan gum solutions form gels on cooling. The setting temperature will depend on the grade of gellan gum, which cations are present and their concentration, and the presence of other dissolved solids.

In the absence of added cations, low acyl gellan gum gels set at around 25°C (77°F), where high acyl sets at around 65°C (149°F). With added calcium or sodium ions, the setting temperature increases.

Low acyl gellan gum typically forms gels in the range of 30 - 50°C (86 - 122°F), while high acyl gellan gum normally forms gels at around 70°C (158°F). Gellan gum sets very quickly, as soon as the setting temperature has been reached. This is known as “snap” setting.

High acyl gellan gum forms a gel simply on cooling. Low acyl gellan gum, however, requires cations, acid, soluble solids or some combination of these additives. Divalent cations such as calcium and magnesium are the most effective for gel formation, but sodium and potassium will also work to form a gel. To optimize gel properties, it is sometimes necessary to add extra cations. Optimization is often accomplished by adding a soluble calcium salt. To avoid localized gelation, the cations are best added when the solution is hot. The solution then gels on cooling.



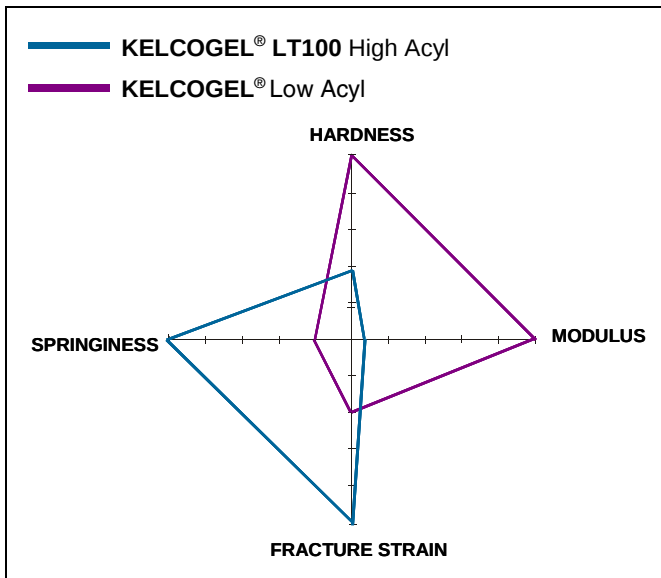


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Gel Texture

One of the most important features of a gelling agent is the texture it provides. Low acyl gellan gum forms hard and brittle gels. High acyl gellan gum forms soft and elastic gels.

Gel Texture Parameters for Low Acyl and High Acyl Gellan Gum



Texture Profile Analysis uses a gel tester to compress a gel specimen twice in succession^(6, 7, 8). The following parameters are measured:

Hardness The maximum force that occurs during the first compression cycle. It usually corresponds to the rupture strength of the gel.

Modulus The perceived firmness when the gel is squeezed by a small amount. It is analogous to the gentle squeezing of a fruit to test ripeness.

Fracture Strain A measure of how the gel can be compressed before it ruptures. A low number is indicative of high brittleness.

Springiness A measure of how much the gel springs back after the first compression cycle. A high number is indicative of a high degree of elasticity.



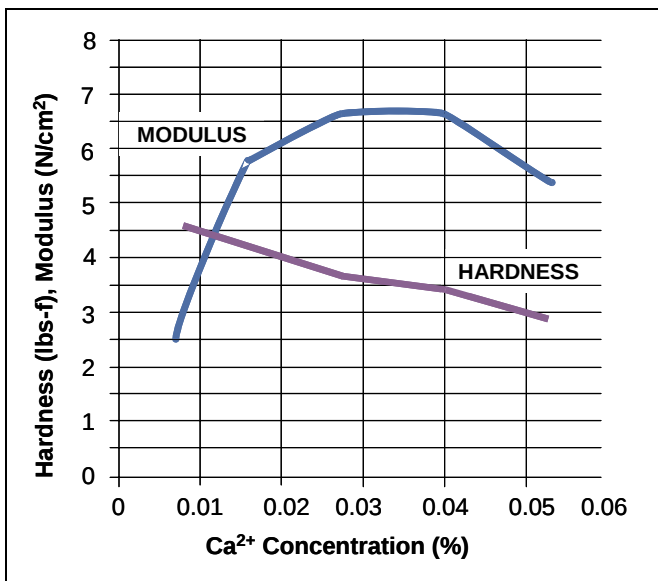
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Factors Effecting Gel Texture

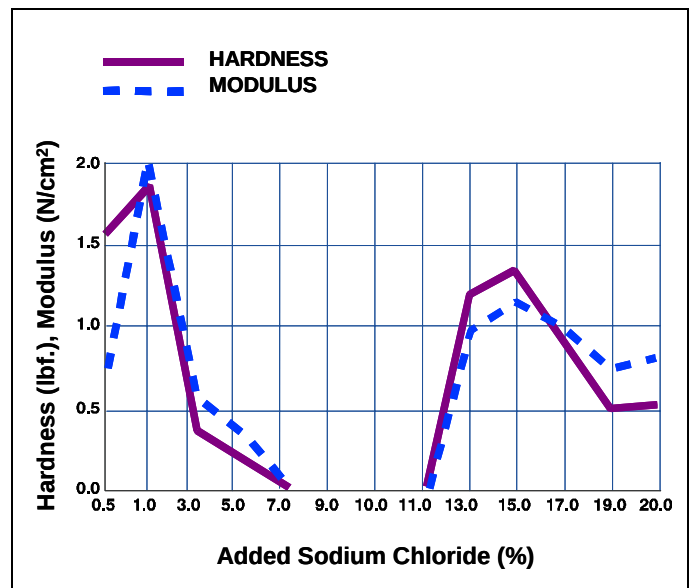
Effect of Cations

For both low and high acyl gellan gum, the gel structure increases sharply with increasing cation levels at moderate levels of calcium and sodium. For low acyl gellan gum, the modulus (gel firmness) increases, passes through a maxima, then decreases as the calcium concentration increases. The hardness falls with added calcium because the gel texture becomes more brittle. A similar response in gel texture is seen for monovalent salts, but the cation concentrations are an order of magnitude higher when compared to divalent cations. Note also, that a second peak is found for higher levels of monovalent ions.

Hardness and Modulus vs Ca^{2+} Concentrations; Low Acyl KELCOGEL[®] Gellan Gum (0.25%)



Hardness and Modulus vs Na Concentrations; KELCOGEL[®] Gellan Gum (0.25%)



Effect of Acids

When the pH is below 3.6, gellan gum gels can be made with hydrogen ions. These gels, known as “acid gels”, have relatively low modulus and hardness values.



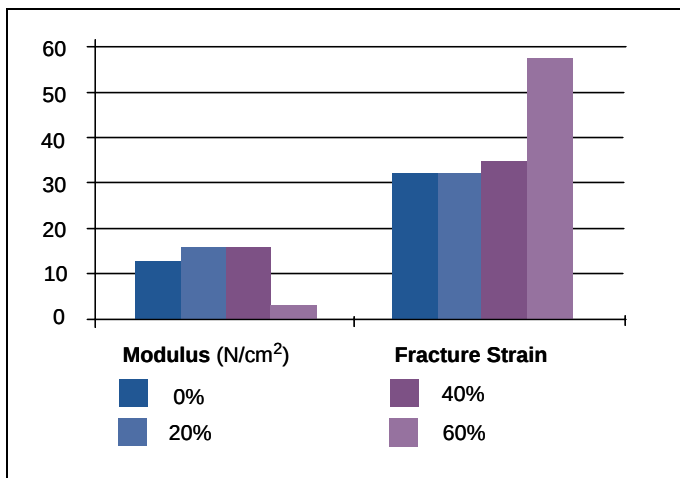
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Effect of Sugars

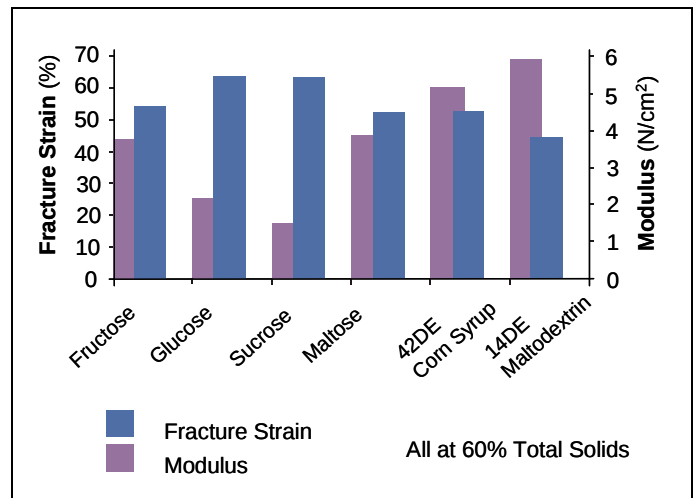
Soluble solids, such as sucrose and other sugars, effect the texture of gellan gum gels. With increasing sugar solids, low acyl gellan gum gels become less brittle and more elastic.

High acyl gellan gum gels also are more elastic above 60% total soluble solids content. The particular sugar also has a marked effect on the gellan gum gel texture. In high sugar systems, optimum gel properties can be obtained with a lower, or no extra, addition of ions. It is, however, necessary to increase the level of gellan gum. Low acyl gellan gum gels do not exhibit 'snap' setting in the presence of high sugar solids.

% Effect of Sucrose on Low Acyl Gellan Gum Gel Texture Parameters



Comparison of Modulus and Fracture Strain for 0.5% Low Acyl Gellan Gum Gels with Different Sugars





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Other Factors

Although resistant to breakdown by common enzymes, gellan gum in the hydrated state, like all polysaccharides, supports bacterial growth. Therefore solutions and gels should be stored under conditions that inhibit bacterial growth. As a dry powder, low acyl gellan gum is remarkably stable, and gels prepared from powder stored for several years are similar to those from fresh material. However, since controlling distribution and storage conditions is difficult, the product should be used within one year of manufacture.

As a carbohydrate polymer, gellan gum is degraded by strong oxidizing agents and mixtures of oxidizing and reducing agents. Additionally, cationic surfactants can cause precipitation through association with the negatively charged carboxyl groups on the polymer. Depending on the amount added, water-miscible organic solvents such as alcohols, precipitate gellan gum from solution. However, moderate levels of these solvents can be tolerated (see table below).

Impact of Other Additives on Shelf Life Stability of Low Acyl Gellan Gum

			Gel Strength (g/cm ²)		
Material	Percent Material	Percent Gellan Gum	Initial	After 30 days	Percent Change
Plasticizers					
Glycerol	15	0.25	288	291	1%
	25	0.25	296	304	3%
Propylene Glycol	15	0.25	276	264	-4%
	25	0.25	174	170	-2%
Alcohols*					
Ethyl Alcohol	10	0.25	166	170	2%
Isopropyl Alcohol	10	0.25	221	193	-13%
Preservatives					
Methyl Paraben	0.3	0.25	249	241	-3%
Propyl Paraben	0.3	0.25	249	245	-2%
Thickeners					
Carboxymethylcellulose	0.25	0.25	154	162	5%
Hydroxyethylcellulose	0.25	0.25	308	296	-4%
Xanthan Gum	0.25	0.25	296	308	4%

The gellan gum was dispersed in deionized water and heated to 80°C with shear. The test material was then added with 4 mM calcium. The samples were poured into four ounce closed containers and stored at room temperature. Readings were taken over a 30 day period using a Voland-Stevens-LFRA Texture Analyser, set to compress the sample 2 mm at a rate of 0.5 mm/sec.

* Samples prepared with 0.04 M sodium ions replacing calcium ions are more stable.



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Blends of Low Acyl and High Acyl Gellan Gum

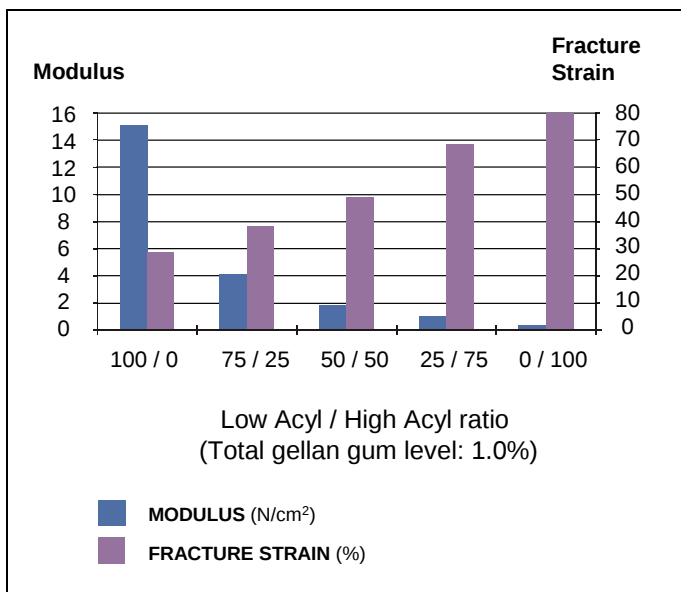
Low acyl gellan gum gels have a firm, brittle texture. Adding a high acyl gellan gum reduces the brittleness.

By varying the ratio of these two forms of gellan gum, a wide variety of textures can be obtained.

Blends of low acyl and high acyl gellan gum can match the texture of other hydrocolloids.

By varying the ratio of low acyl and high acyl gellan gums it is possible to obtain textures close to those of carrageenan and gelatin gels.

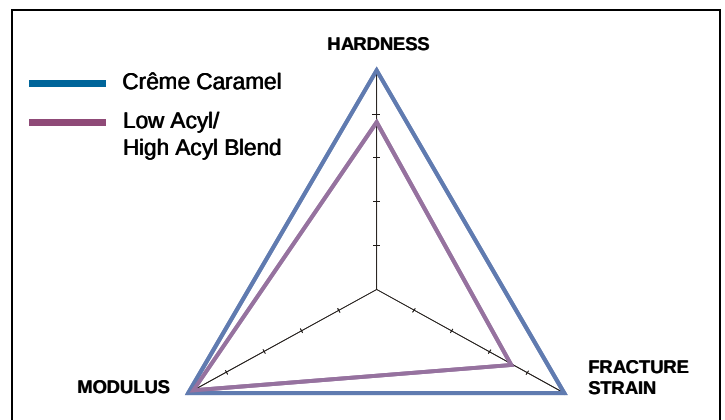
Textural Modification using Low Acyl Gellan Gum in Combination with High Acyl Gellan Gum



Comparison of a Gelatin Table Jelly with a Low Acyl / High Acyl Gellan Gum Blend



Comparison of a Ready-to-eat Crème Caramel with a Low Acyl / High Acyl Gellan Gum Blend



Blends with other Hydrocolloids

Other thickening or gelling agents, such as starch, guar gum, locust bean gum, cellulose derivatives or xanthan gum, may also be used with gellan gum in order to obtain the desired texture. Certain hydrocolloids, when combined with low acyl gellan gum, cause a progressive reduction in the hardness and modulus values of the gellan gum gels. Brittleness remains essentially constant and springiness increases slightly.



KELCOGEL[®] Gellan Gum

Thermo-reversible Gels

In most practical situations, gels made with low acyl gellan gum are not thermally reversible. Most gels of low acyl gellan gum are retort or bake-stable. Gels made with high acyl gellan gum will soften with heating, and will melt with prolonged heating.

The greater the concentration of ions, the higher the melting temperature.

Milk Systems. Gels made with low concentrations of monovalent ions melt easily. For example, in milk systems both high and low acyl gellan gum form thermo-reversible gels as it is believed that in milk, gellan gum sets predominately with potassium rather than calcium ions.

Degradation during Gel Preparation

Low acyl gellan gum is very stable. Like other polysaccharides, gellan gum will undergo hydrolytic degradation at high temperature, especially in acidic conditions. However, at pH 3.5, a low acyl gellan gum solution can be maintained at 80°C for up to one hour with minimal deterioration in the quality of the subsequently formed gel. High acyl gellan gum is more susceptible to degradation so long hold times in acidic conditions should be avoided. For UHT milk process systems, the low acyl form of gellan gum should be used for long-term product stability.



KELCOGEL[®] Gellan Gum

The Beneficial Properties of Gellan Gum Fluid Gels

Gellan gum fluid gels are solutions with a weak gel structure. They exhibit an apparent yield stress, i.e., a finite stress which must be exceeded before the system will flow. These systems are very good at suspending particulate matter since, provided the stress exerted by the action of gravity on the particles is less than the yield stress, the suspension will remain stable.

Their highly pseudoplastic flow provides extremely efficient suspension combined with low viscosity at higher rates of shear. This results in low viscosity in the mouth, making them particularly effective in beverages for suspension of fruit pulp or jelly pieces. Suspension can be achieved without adversely affecting the mouthfeel.

Other important properties of gellan gum fluid gels are the setting temperature, degree of structure and thermal stability. All of these properties are, as with normal unsheared gels, dependent upon the concentration of gellan gum and the type and concentration of gelling ions.

Fluid gel formation is employed in the production of dairy products, spreads, dressings, and sauces using scraped surface heat exchangers or during HTST/UHT processing.

Gentle agitation of a weak gellan gum gel, after it has set, is also sufficient to form a smooth, pourable fluid gel. This means that fluid gels can be formed using standard filling operations.





KELCOGEL[®] Gellan Gum

Compatibility

Surfactants. KELCOGEL[®] CG gellan gum is compatible with up to 20-35% nonionic surfactants. Anionic and amphoteric surfactants tend to salt out gellan gum above a surfactant concentration of 15%. KELCOGEL CG gellan gum is an anionic polymer and, therefore, tends to be incompatible with cationic surfactants. This incompatibility can be controlled or prevented in certain cases by adding an electrolyte.

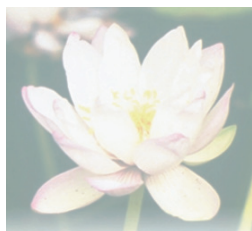
KELCOGEL CG gellan gum has good compatibility with various concentrations of surfactants. However, the order of addition will be important to the proper hydration of gellan gum. Compatibility should be tested under actual conditions because other factors like the presence of salts, acids, and bases may be influential.

The following data is based on stability tests with a fluid gel formulation of KELCOGEL[®] gellan gum, at 0.1% gum concentration.

Acid/Base Compatibility. KELCOGEL CG gellan gum has demonstrated good stability over a wide range of pH from less than pH 3 to at least pH 13. At very low pH, acid hydrolysis can occur leading to depolymerization, especially at elevated temperatures. Because the gel strength of gellan gum is governed by the type and concentration of ions, its gel strength may vary with changing pH. However, the gellan molecule remains intact. The preparation of formulations containing acids and bases may affect the solubility temperature of the gellan gum. Therefore, the proper order of addition should be considered to enable full hydration of the gum.

Gellan Gum Compatibility with Various Surfactants

Surfactant	0.1% KELCOGEL [®]	0.1% KELCOGEL [®] LT100
Sodium lauryl sulfate	15	10
Triethanolamine lauryl sulfate	15	15
Sodium laureth (3EO) sulfate		10
Sodium C ₁₄ -C ₁₆ alpha-olefin sulfonate	15	5
Sodium linear dodecyl benzene sulfonate	15	5
Sodium lauroyl sarcosinate	5	<5
Disodium laureth sulfosuccinate	15	
Ammonium cocoyl isethionate	20	
Coco amidopropyl hydroxysultaine	15	
Linear alcohol ethoxylate (3EO)	<5	<5
Linear alcohol ethoxylate (7EO)	25	20
Linear alcohol ethoxylate (9EO)	30	30
Secondary alcohol ethoxylate (7EO)	30	
Octyl phenol ethoxylate (HLB=14)	35	30
Nonyl phenol ethoxylate (HLB=15)	35	35
C ₉ -C ₁₁ alkyl polyglycoside	30	35
Poly(oxyethylene)-20 sorbitan monostearate	5	5
Ethylene oxide-propylene oxide block copolymer (HLB=19)	25	
Ethylene oxide-propylene oxide block copolymer (HLB=22)	10	10



KELCOGEL® Gellan Gum

KELCOGEL® Gellan Gum Products

Gellan Gum Product	Application	Acyl level	Solution clarity	Particle size
KELCOGEL®	Food	Low	Transparent	42 (355µm)
KELCOGEL® AFT	Industrial	Low	Transparent	42 (355µm)
KELCOGEL® CG-LA	Pharmaceutical, Oral Care and Personal Care	Low	Transparent	42 (355µm)
KELCOGEL® CG-HA	Pharmaceutical, and Personal Care	High	Milky	42 (355µm)
KELCOGEL® F	Food	Low	Transparent	100 (150µm)
KELCOGEL® LT 100	Food	High	Milky	42 (355µm)
GELZAN CM™	Microbiological media and plant tissue culture	Low	Transparent	42 (355µm)

KELCOGEL® Gellan Gum Specialty Products

A range of specialty products for a variety of food formulation needs

Gellan Gum Product	Ingredient Label	Typical Applications
KELCOGEL® IF	Sugar Gellan gum Sodium citrate	Icings, frostings, piping jellies, low- and reduced-fat frostings, sweet roll icings, royal icings
KELCOGEL® JJ	Sodium citrate Gellan gum	Non-standard jams and jellies, fruit fillings
KELCOGEL® BF	Sodium citrate Sugar Gellan gum	Bakery fillings Yogurt fruit
KELCOGEL® BF10	Sugar Gellan gum Sodium citrate	Bakery fillings (high solids) Yogurt fruit
KELCOGEL™ PS	Sugar Gellan gum Pectin	Fruit juices Pulp suspension
KELCOGEL® HM-B	Sugar Gellan gum	Dairy milk beverages
KELCOGEL® HS-B	Sugar Gellan gum	Neutral soy beverages

Technical bulletins and formulations giving more details of our recommendations are available.



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Applications

The following applications are intended merely to illustrate **KELCOGEL[®]** gellan gum's versatility. Its ultimate value will be determined by the demands and ingenuity of the end-user.

Food Applications

Gellan gum functions as a structuring and gelling agent in a wide variety of foods. Typical examples are shown in the table below. Although gellan gum can be used effectively by itself in many products, its benefits sometimes are better realized in combination with other food hydrocolloids. Irrespective of whether the products are pre-processed, ready-to-eat, or reconstituted from a dry mix, gellan gum has been found to perform with a high degree of success, provided the simple principles for hydration and gel formation are followed. Many formulations to assist in product development are available upon request.

Typical Food Applications of Gellan Gum

Major Food Area	Typical Products
Confectionery	Starch jellies, pectin jellies, fillings, marshmallows
Jams and jellies	Reduced-calorie jams, imitation jams, bakery fillings, jellies
Fabricated foods	Fabricated fruits, vegetables, meats
Water-based gels	Dessert gels, aspics
Pie fillings and puddings	Instant desserts, canned puddings, pre-cooked puddings, pie fillings
Icings, frostings and glazes	Bakery icings, canned frostings
Dairy products	Ice-cream, gelled milk, yogurt, milkshakes, low-fat spreads, dips
Beverages	Fruit, milk-based, soy and carbonated drinks
Films/Coatings	Batters, breadings, coatings, adhesion systems



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Gelled Products. Water-based dessert gels are popular throughout the world and have a range of textures. Gellan gum can furnish textural diversity in these products coupled with outstanding flavor release. Products can be "ready-to-eat" or in dry mix form. As previously mentioned, small amounts of gellan gum can be used in gelatin desserts to improve heat stability and raise the setting temperature so gels will set without refrigeration. Gellan gum also improves the heat stability of other gelled products prone to melting when exposed to high ambient temperatures. Savory gels or aspics sometimes are used in specialty meat, fish and vegetable products to provide added appeal and succulence. Gelatin usually is the gelling agent of choice. Again, gellan gum can be used wholly or partly in place of the gelatin to improve the characteristics of the aspic.



Fruit-Based Products. Although not currently permitted as an additive in standardized high-sugar jams and jellies, gellan gum is ideal for the formulation of non-standardized analogs, in particular increasingly popular fruit spreads containing reduced quantities of sugar. High methoxyl pectin, the gelling agent

allowed in standardized products, requires careful control of pH and a high sugar level for gel formation and hence cannot be used in the low solids versions. Low methoxyl pectin or k-carrageenan, currently the most popular alternatives, are not entirely satisfactory and sometimes do not provide the desired in-process and storage stability. Gellan gum offers robustness during processing, provides good product stability during transportation and storage, and through its characteristic gel texture and low-concentration requirement, creates products with excellent taste and appearance. The ease with which gellan gum can be used is a particularly attractive attribute for the manufacturer. **KELCOGEL® JJ** gellan gum performance product was developed specifically for use in non-standardized jams and jellies.



Starch-Based Products. Fruit fillings are widely used in bakery products and are similar to jams and jellies but frequently contain starch. Consequently, in these products, gellan gum provides the benefits obtained in jams and jellies together with those in starch products, such as increased stability of the starch paste, additional structure and reduction of starch levels. The added structure, coupled with the ability of the pastes to partially recover structure after shearing and depositing, result in fillings that



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retain water, show good "bakefastness" and are appealing to the consumer when used in products such as pies, pastries and turnovers. **KELCOGEL[®] BF** is the gellan gum performance product developed specifically for bakery fillings with solids of less than 50° Brix. **KELCOGEL[®] BF10** is developed for higher solids bakery fillings (>50° Brix).

Similar to bakery filling, puddings are dessert and snack items that usually contain starch as the primary thickener. They are available in various ready-to-eat forms, or can be easily prepared from a dry mix using water or milk. The term "pudding" refers to the fact that they are thick and pasty in consistency, rather than short textured and gel-like in structure. Since products of this type have widespread consumer appeal, it is usually not appropriate to include gelling agents that bring about undesirable textural modifications. However, gellan gum is acceptable because, at the low levels needed to impart structure and additional stability to the paste, the characteristic starchy mouthfeel is retained. When gellan gum is used with starch, the standard processing techniques applicable to starch do not need to be modified. In this respect, the good stability of **KELCOGEL** to the various heat treatments, to which starch products are subjected, is a particular benefit. **KELCOGEL[®] BF** and **KELCOGEL[®] BF10** are gellan gum performance products designed for use in puddings.

High Solids Products. Starches, pectin, gelatin and agar, sometimes with other ancillary hydrocolloids, are used in the preparation of gelled confections. Typical products include starch jellies, gummy candies, pastilles, pectin jellies and marshmallows. Since these products are made by heating and cooling, gellan gum often can be used in their manufacture without process modifications.



By using gellan gum in combination with the appropriate starch, it is possible to reduce the set time of starch jellies so they can be removed more quickly from the starch molds. Textural variations are obtained by adjusting the ratio of starch to gellan gum and the total amount of each in the formulation. Gellan gum can impart increased heat stability to gelatin confections, resulting in a product that stores better at high ambient temperatures. Gellan gum also has been used alone to produce a variety of confections with novel, appealing textures, noticeably pleasing flavor impact, and remarkable shelf stability. **KELCOGEL[®] F** is typically used in high solids products.



KELCOGEL® Gellan Gum

Decorative icings, frostings and glazes for baked goods consist primarily of sugar and water, with other optional ingredients such as fat, color, flavor, air, emulsifiers and milk solids. Stabilizing these products sometimes is difficult and many different hydrocolloid systems are used. With the possible exception of agar, no single gum has emerged as the stabilizer of choice. Gellan gum, being similar to agar, has been tested in a number of different formulations and found to be useful. Benefits obtained from gellan gum include good shelf stability, moisture retention, spreadability, sheen, texture and flavor release. **KELCOGEL® IF** is a gellan gum performance product developed specifically for icings, frostings and glazes.



Beverages. **KELCOGEL®** gellan gum can provide added benefits to beverages. Various beverages may be stabilized using *fluid gel* technology, which is a technique commonly used in the production of many food products, including custards and gravies, in which a fluid mass is formed as a result of homogenization, HTST or UHT processing while cooling. Fluid gels are usually formed by agitating the fluid mix during the cooling cycle which disrupts the normal gel formation process.



Very low levels of **KELCOGEL®** gellan gum products and specialty blends will produce fluid gels. Using gellan gum fluid gel technology, good suspension at a low viscosity can be achieved. CP Kelco offers a number of ingredients specially targeted to specific beverage applications.

KELCOGEL® gellan gum can be used at 0.03% to create transparent novelty drinks by suspending beads, pulp sacs, or fruit bits in a beverage.

For juice-based beverages, CP Kelco offers **KELCOGEL™ PS** hydrocolloid blend. At 0.3%, **KELCOGEL PS** gellan gum hydrocolloid blend can suspend fruit pulp leading to a uniform appearance in fruit juice-based beverages.

For flavored milks, nutritional beverages, RTD coffee and teas, or other dairy-based beverages, **KELCOGEL® HM-B** gellan gum is used at 0.12% for suspending particles like cocoa and tricalcium phosphate. **KELCOGEL® HM-B** is especially tolerant to differences in protein levels,



KELCOGEL[®] Gellan Gum

heat-damaged proteins, calcium salts, and other nutritional ingredients. Soy milk and soy beverages can be especially difficult to stabilize. However, with 0.12% of **KELCOGEL[®] HA-B** gellan gum, soy proteins, cocoa and insoluble calcium salts can be suspended without introducing excessive mouthfeel.

In beverages, it is possible to hot fill and allow the system to cool to form a very weak gel. Subsequent shaking of the package would then disrupt the gel, producing a pourable fluid with a very short texture similar to that of a fluid gel made by shearing while cooling. Flavor and texture of beverages such as chocolate milk, pulp-containing fruit drinks or suspended insoluble minerals, and carbonated beverages can be modified to enhance mouthfeel using *fluid gel* technology.

Fluid gel technology can be extended to other application areas, such as low/no fat pourable dressings, chocolate milk drinks, sauces, stirred yogurts, ice cream, toppings, thickened cream, and any other products requiring a low viscosity suspension.

To develop novel beverage products, **KELCOGEL[®]** gellan gum beads containing various colors and flavors can be added to drinks. The formation of **KELCOGEL[®]** gellan gum beads involves diffusion setting by dripping a hydrated solution of gellan gum into a flavor system naturally high in ions. The flavors then diffuse into the gellan gum sphere to form beads. In addition, carbonated beads can be made by adding calcium carbonate to a hydrated solution of gellan gum, and then dripping the solution into citric acid, or naturally acidic fruit juice. Acids from the juice promote gel formation and also cause the calcium carbonate to solubilize, producing carbon dioxide which is trapped inside the beads. In a hermetically sealed container, these beads provide a method for carbonating beverages.

KELCOGEL gellan gum beads made by diffusion can be extended to various flavor applications. Examples include soy sauce, vinegar, garlic juice, onion juice, and fruit concentrates. These flavors contain ions, such as calcium, sodium, and hydrogen ions and promote gel formation with gellan gum. The beads can be combined with oil to produce unique salad dressings, or can be dried out and used for instant gravy or soup mixes. Fruit flavored beads can be used for ice cream and yogurt mixes, or if dried put into breakfast cereals.

Dairy Foods. Upon heating and cooling in milk, gellan gum produces a delicately textured gel. This ability to form gels in the presence of milk protein has led to the evaluation of gellan gum as a structuring agent and stabilizer in a variety of dairy products, such as flans, ice cream, yogurt and sour cream. A number of product prototypes have been successfully developed. Combining gellan gum with starch contributes valuable characteristics such as good stability, starch-like texture, improved flavor and ease of processing. The heat stability and low hot-temperature viscosity of gellan gum are advantageous for use in products subjected to UHT and HTST treatment.

Farinaceous Foods. Thickeners, such as xanthan gum, guar and CMC are sometimes used in cakes for recipe tolerance, better moisture retention, more uniform crumb structure and improved stability. Gellan gum provides similar advantages, and one can assume that flour-based products containing gums, such as pasta, tortillas and variety breads, may also benefit by adding gellan gum.

Asiatic Foods. In South East Asia, texture is a very important characteristic in foods as evidenced by the wide range of distinctly defined food textures available in the region. Often foods are eaten for their texture rather than their flavor. Foods such as birds nest, sea cucumber, jelly fish and shark fin



KELCOGEL® Gellan Gum

have little or no flavor but possess a highly desirable texture. These types of food are generally in short supply and command very high prices, yet they are still in great demand. **KELCOGEL®** gellan gum products can be used to simulate the texture of these types of Asiatic foods.



Drinking jellies have gained popularity in South East Asia. They are weakly gelled products which can either be consumed through a straw or directly from the container as the weak gels are broken down by shaking. Gellan gum can be used to form clear, thermostable water-based drinking jellies. Jelly pieces have been added to drinks to give texture and provide a cooling sensation to the back of the throat when consumed in conjunction with spicy foods.

Emulsions. Many foods are emulsions — both oil-in-water and water-in-oil. Thickeners are widely used in the former to provide stability. In the latter, thickeners and gelling agents are being used increasingly to help maintain product quality when oil or fat is removed and replaced with water. Gellan gum has been used in both types of emulsions, for example, as a stabilizer in imitation mayonnaise and a structuring agent in low-fat spreads.

Gellan gum's utility in emulsions and cakes illustrates that it is not solely a gelling agent but can also be used in other applications where structure and stability, rather than gel formation, are required.

Films and Coatings. **KELCOGEL®** gellan gum forms films and coatings that can be used in breadings and batters for chicken, fish, cheese, vegetables, potatoes, and dough-enrobed items like egg and pizza rolls. Films offer several advantages, particularly their ability to reduce oil absorption by providing an effective barrier. In batters, for example, product crispness is maintained long after frying or baking, which helps maintain product quality under heat lamps. Films are prepared by applying a hot solution of gellan gum onto the surface of the food product, by spraying or dipping, and allowing to cool. Alternatively, the food can be dipped into a cold solution of gellan gum, allowing ions to diffuse into the solution, resulting in gelation or film formation.

Breaded products also can be formulated by spraying or dipping with an aqueous solution of gellan gum, then partially baking or freezing. The product can then be heated in an convection or microwave oven, giving the appearance of a fat-fried product. Since these products are not deep-fat fried, the fat content is reduced, or sometimes eliminated.

Adhesion Systems. One film-forming application that has recently drawn interest is the **KELCOGEL®** gellan gum adhesion system. Gellan gum produces an easy-to-use, fat-free adhesion system. The water-thin solution is sprayed onto the product to be coated, such as crackers, cookies, pretzels, potato or corn chips, and rice cakes. This thin solution facilitates formation of a very fine mist that optimizes spraying efficiency and reduces nozzle plugging.

Spice, flavor or sweetener blends can be incorporated in the spray solution itself or can be applied directly after spraying the product with the **KELCOGEL** gellan gum solution. Other flavoring products can be adhered such as fruit bits, herbs and dairy-based powders. This system can be used in place of oil to reduce the overall fat content of the final product.



KELCOGEL[®] Gellan Gum

Other Applications

Microbiological media. **GELZAN CM**[™] gellan gum can be used to formulate a suitable growth matrix for most clinical and non-clinical organisms. The similarity between agar and **GELZAN CM** gellan gum has led to the commercialization of **GELZAN CM** as an alternative to agar for microbiological media. Studies using 50 different bacterial species show that **GELZAN CM** gellan gum can not only replace agar in many routine media applications, but can also give a higher degree of cell growth in certain situations.

GELZAN CM gellan gum is particularly useful for the culture of thermophilic microorganisms, as the gels are thermostable and can withstand prolonged incubations at high temperatures. In addition, acceptable gel strengths can be obtained using **GELZAN CM** gellan gum at a lower level than agar, and spreader colonies do not become too large.

GELZAN CM gellan gum has demonstrated superiority over agar for cultivation of mesophilic *Methanobacterium* and *Methanobrevibacter* organisms – with greater gel strength, reduced preparation time for plates, drier media, and in the case of mesophilic *Methanobacterium* species, reduction of the extended incubation times. In these microbiological media applications, the high purity of **GELZAN CM** gellan gum and the water-like clarity of the gels are distinct additional advantages.

Plant tissue culture. Agar is currently the gelling agent of choice for plant tissue culture. However, the presence of impurities or inhibitory factors (including sulfur) in agar can adversely affect growth. **GELZAN CM**[™] gellan gum offers a promising alternative to agar in this application because of its purity. Studies on a limited number of plant species show that growth is indeed improved on media containing **GELZAN CM** gellan gum. In addition, **GELZAN CM** used at one-fifth the agar use level, resists contamination by molds, is easily washed from the plant tissue for transplanting, and allows clear observation of root and tissue development.

Air Fresheners. **KELCOGEL**[®] **AFT** gellan gum enables air freshener gels of crystal clarity to be formulated. The high melting temperature of these gels make them suitable for use in hot environments, such as cars.



Paper. **KELCOGEL**[®] **LT100** gellan gum is an excellent film former useful to increase the internal strength of paper and as a sizing agent to improve ink jet printability.



KELCOGEL[®] Gellan Gum

Pharmaceutical Applications

KELCOGEL[®] CG-LA gellan gum can be used to produce easy-to-swallow solid dosage forms, such as gels and coated tablets, and to modify the rate of release of active ingredients from tablets and capsules.

Personal Care Applications

In personal care products, such as sunscreens, lotions, and mild hair conditioners, gellan gum has been used as a structuring rather than gelling agent, providing body, stability, and pleasing skin feel. In some cases, performance is further improved by the inclusion of xanthan gum or xanthan/locust bean gum.

KELCOGEL[®] CG-LA gellan gum (low acyl) and **KELCOGEL[®] CG-HA** gellan gum (high acyl) are designed specifically for use in personal care applications. Both products are tested to ensure compliance with the purity criteria defined in the monograph for gellan gum in the current edition of the US pharmacopoeia/National Formulary.



Hair Care Products. **KELCOGEL[®] CG** gellan gum can provide effective stabilization and suspension of shampoo and conditioner formulas. Gellan gum is ideally suited to products requiring a pseudoplastic (shear thinning) rheology. General usage levels are 0.2% or less when used in combination with other polymers.

Creams and Lotions. Creams and lotions are primarily oil-in-water emulsions that are creamy with no trace of oiliness or wetness. The high yield value of **KELCOGEL[®] CG** gellan gum fluid gels effectively stabilizes these emulsions and imparts a 'light and silky' feel when rubbed on the skin. Gellan gum also keeps emulsions stable during temperature fluctuations, for consistent quality in transit, as well as on the shelf. Recommended use levels are 0.25% or less.

Suntan Lotions and Sunscreens. Just as with other creams and lotions, **KELCOGEL[®] CG** gellan gum stabilizes the oil phase and delivers the important ingredients to the skin in a uniform manner. Gellan gum offers excellent stability over the wide range of temperatures that these products experience. Usage levels for suntan lotions and sunscreens are comparable to those given for creams and lotions.



KELCOGEL[®] Gellan Gum

Oral Care Applications

KELCOGEL[®] CG-LA gellan gum is advantageous in toothpaste formulations both for its binding properties and its gel-like texture. It produces a reversible, non-stringy, true-gel structure in many types of toothpaste formulations. This structure build of gellan gum may allow the reduction or elimination of thickening silica in some formulations.

KELCOGEL[®] CG gellan gum provides excellent flavor release and, therefore, reductions of flavor and saccharin levels (by 10-25%) are often possible.

At typical use levels, **KELCOGEL[®] CG** gellan gum contributes very little viscosity during toothpaste preparation allowing the design of highly fluid, low viscosity formulations that subsequently form a gel after packaging. This low viscosity performance makes manufacturing and packaging easier and allows the incorporation of fragile ingredients (e.g., encapsulated flavors, actives, etc.) that would not normally be possible with typical binder systems.

Using variations of low and high acyl, **KELCOGEL[®] CG** gellan gum can produce toothpastes with a variety of binding, stand-up and preparation viscosity. Blends of gellan gum with other polymers such as xanthan gum, sodium carboxymethyl cellulose, hydroxyethyl cellulose, carrageenan and carbomer are possible and can provide additional mouthfeel and water binding properties to the formulations. When relatively high levels of gellan are used, these other polymers may be added to give a smoother consistency.

Features of KELCOGEL[®] gellan gum in toothpaste

- Low use levels (0.025%-0.25%)
- Short, non-stringy flow even in low-water formulations
- Excellent stand-up
- Reversible gel-like structure
- Gel structure will not melt even at high temperatures (>60°C (140°F) melting temperatures)
- Low viscosity contribution during toothpaste/gel preparation
- Delayed gel structure over several hours to 24 hours after preparation
- Excellent flavor release allowing lower flavor and sweetener levels
- Excellent stability to enzymes, pH, and high shear
- Compatible with many actives such as tartar control salts and anti-plaque agents
- Fast break-down in mouth





KELCOGEL[®] Gellan Gum

Regulatory Status

Gellan gum first received approval for food use in Japan in 1988. It is now approved for food, non-food, cosmetic and pharmaceutical use in the United States, Canada, Australia and many other countries in Latin America, South America, Asia, and the European Union.

Below is a partial list of approvals for the use of gellan gum. Space restrictions preclude a complete listing.

Gellan gum appears in the USP/NF (first Supplement April 1, 2004 USP 27/NF 22).

Gellan gum is an approved FDA food additive as per 21 CFR 172.665. Gellan gum appears as E418 in the European Community Directive EC/95/2 in Annex 1. Gellan gum is listed in the Food Chemicals Codex, Canada Food and Drug Act (Division 16, Table IV, G.2), Japanese Specifications and Standards for Food Additives (JSSFA).

Both the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and the European Community Scientific Committee for Food have given gellan gum an Acceptable Daily Intake (ADI) of “not specified”.

Combinations of high acyl and low acyl gellan gum have one name. A manufacturer may label a product made with a combination of both types of gellan gum “E418” (EU) or “gellan gum”.

Gellan gum has many industrial uses and is listed on the US TSCA inventory, Canadian NDSL, and European EINECS.

Gellan gum is exempt from the requirement of a tolerance when used in pesticide formulations (40 CFR §180.950).

KELCOGEL[®] CG gellan gum products are manufactured to food GMPs and are tested to ensure compliance with the purity criteria defined in the monograph for gellan gum in the current edition of the US Pharmacopoeia / National Formulary.

For specific applications and regulatory status please contact CP Kelco Regulatory Affairs.



KELCOGEL[®] Gellan Gum

CP Kelco Research and Development

We continually seek new hydrocolloids, and other ingredients with interesting properties for our food customers. In this, we use our own efforts and also cooperate with universities, research institutes, and specialist companies.

Research and development is a top priority for CP Kelco. We have research sites at two locations: San Diego, California, USA and Skensved, Denmark.



Application Development and Technical Service

Working in parallel are teams who translate the more fundamental work to the needs of specific products and specific customers. Often this work is carried out in a confidential partnership.

We have a database of over 1,000 food formulations.

Our assistance to customers is designed to be fast, friendly, efficient, and above all, helpful.

Our technical-sales staff visits customers' plants to ensure that, under real manufacturing conditions, formulations and processes work just as they did in the laboratory. Technical Service facilities are located in Leatherhead, Paris, Hamburg, Chicago, San Diego, and Singapore.



KELCOGEL[®] Gellan Gum

Manufacturing

CP Kelco manufactures gellan gum at our biogums operation in San Diego, California.

Gellan gum, like all biogums with commercial value to the food industry, have highly viscous solutions at low viscosities. Because of this, sophisticated process techniques are needed.

Our experience with respect to viscous fermentation technology is second-to-none and has a considerable accumulation of know-how. New fermentation products add to our fund of processing knowledge.

We're a long way along the experience curve.



BIBLIOGRAPHY

1. Kang, K.S., Veeder, G.T., Mirrasoul, P.J., Kaneko, T. and Cottrell, I.W., *Agar-like polysaccharide produced by Pseudomonas species: production and basic properties*. Appl. Environ. Microbiol., 43 (1982) 1086.
2. Grasdalen, H. and Smidsrod, O., *Gelation of gellan gum*. Carbohydrate Polymers, 7(1987) 371.
3. O'Neill, M.A., Selvendran, R.R. and Morris, V.J., *Structure of the acidic extracellular gelling polysaccharide produced by Pseudomonas elodea*. Carbohydrate Res., 124 (1983) 123.
4. Jansson, P.E., Lindberg, B. and Sandford, P.A., *Structural studies of gellan gum, an extracellular polysaccharide elaborated by Pseudomonas elodea*. Carbohydrate Res., 124 (1983) 135.
5. Kuo, M.S., Dell, A. and Mort, A.J., *Identification and location of L-glycerate, an unusual substituent in gellan gum*. Carbohydrate Res., 156 (1986) 173.
6. Szczesniak, A.S., *Classification of textural characteristics*. J. Food Sci., 28 (1963) 385.
7. Friedman, H.H., Whitney, J.E. and Szczesniak, A.S., *The texturometer - a new instrument for objective texture measurement*. J. Food Sci., 28 (1963) 390.
8. Szczesniak, A.S., Brandt, M.A. and Friedman, H.H., *Development of standard rating scales for mechanical parameters of texture and correlation between the objective and the sensory methods of texture evaluation*. J. Food Sci., 28 (1963) 397.



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