CHAPTER 15

Gums, Gellants, Bulking Agents and Thickeners

Thickeners are used to control phase separation, prevent syneresis, extend shelf life, add volume, slow down or eliminate crystal growth, help suspend particulate materials, form gels and have a positive effect on product application, e.g. spreadability, delivery.

Acacia senegal. Gum Arabic, Cape Gum, Egyptian Thorn

It is found in North Africa from Abyssinia to Senegal. It is found in the Sudan, particularly the province of Kordofan, in Central Africa and West Africa. The gum exudes from the tree naturally, but larger yields are obtained by making incisions. The main component is arabin, the calcium salt of arabic acid. The structure of the gum is complex and has not yet been fully elucidated. The gum is built upon a backbone of D-galactose units with side chains of D-glucuronic acid with L-rhamnose or L-arabinose terminal units. The molecular weight is 200,000 to 600,000 Daltons. Acacia gum is demulcent, and soothes irritated mucous membranes. Consequently, it is widely used in topical preparations to promote wound healing and as a component of cough and some gastrointestinal preparations. Domestically it is also used as an adhesive. It does have slight thickening properties but is too sticky to be helpful. The blending with tragacanth gum helps reduce the tackiness.

Algae Extract

The term "algae" is normally used to denote a complex mixture of many seaweeds, which include the red, brown, green and blue classes. Seaweeds contain much higher levels of minerals than terrestrial plants and also contain a rich selection of trace elements, amino acids, short chain proteins and polysaccharides. The polysaccharides are of particular importance, since these natural sugars can have a profound benefit on the skin, especially in the areas of moisturization, skin smoothing and skin softening.

There is a gellant obtained from selected classes of red and brown seaweed (algae) collected in unpolluted tropical waters of the Brazilian Northeastern coast. In water this gives a white opaque gel that is quick to break and non-tacky. It is said to be highly substantive to hair and skin, provides good moisturizing properties, and helps to protect skin, hair and scalp.

Algenic Acid or Algin

The brown algae are multicellular and have differentiated structures that, in some species, bear a superficial resemblance to the roots, stalks, and leaves of more advanced plants. These structures, however, are quite different internally. The cell walls of the algae are made of cellulose similar to that found in red algae; the outsides of the walls are covered by a gelatinous pectic compound called algin. Bladder wrack contains 18–30% of algin. The algenic acid is a mix of polyuronic acids ($C_6H_8O_6$) that are made of "homogenous blocks" of mannuronic or guluronic acids of 20–30 units. Between the blocks, there are some sequences that are formed by association of the monomers. The well-structured blocks resist to hydrolysis while the badly structured blocks quickly degrade. The rate that D-manuronic acid or guluronic acid changes depends on the season and the place of the harvest. It is mainly used for its thickening, gel forming and stabilizing properties.

Algin

Algin is an extract from brown algae* (seaweed) and used as a stabilizing ingredient that binds oil and water components together. Derivatives may also be listed as potassium alginate and sodium alginate, while alginic acid is a gellike extract that provides thickening and stabilizing properties. Since algin can absorb up to 300 times its own weight in water, it also provides lubricating and moisturizing benefits to body and skin care products.

Alginic acid—see also Algae Extract

The gelling properties of alginic acid, the major polysaccharide in brown seaweeds including fucus, are extensively used in the dairy and baking industries to improve texture, body and smoothness of products.

Amorphophallus konjac. Konjac

It is a food species of Yunnan and Sichuan. It is grown in fields by upland farmers. Its tubers have received attention as a diabetes food. They contain *Konjac glucomannan* which is an excellent dietary fiber. Konjac flour is obtained from the tubers of various species of *Amorphophallus*. It is a soluble dietary fiber that is similar to pectin in structure and function. Konjac flour consists mainly of a hydrocolloidal polysaccharide, glucomannan. Glucomannan is composed of glucose and mannose subunits. It is a slightly branched polysaccharide having a molecular weight of 200,000–2,000,000 Daltons. Acetyl groups along the glucomannan backbone contribute to solubility properties and are located, on average every 9 to 19 sugar units. In general, the konjac tuber is ground and milled, and its impurities are separated by either mechanical separation, or washing with water or aqueous ethanol to produce konjac flour. A proprietary mixture of konjac mannan and xanthan gum is available (under the name Glucovis) and is the nearest natural alternative to Carbomer.

Anogeissus latifolia. Ghatti Gum

Gum Ghatti is the amorphous translucent exudate of the *Anogeissus latifolia* tree. The gum is locally known as *Dhavda* and when first exuded, is soft and plastic. The color varies from whitish yellow to amber. Gum Ghatti is a complex polysaccharide of high molecular weight. It occurs in nature as a mixed calcium, magnesium, potassium and sodium salt. It is composed of L-arabinose, D-galactose, D-mannose, D-xylose and D-glucoronic acid in a molar ratio of 10:6:2:1:2 plus traces (<1%) of 6-deoxyhexose. Gum Ghatti disperses in water to form a colloidal dispersion. It does not form a true gel, but forms viscous solutions that exhibit typical non-Newtonian behavior. Gum Ghatti is a moderately viscous gum lying intermediate between Gum Arabic and Gum Karaya. It is quite a good emulsifier. The normal pH of the dispersion is 4.8 and the solutions are sensitive to alkali. The viscosity increases sharply with pH up to a maximum at about pH 8 after which the solutions tend to become stringy. Viscosity values increase with age.

Astragalus gummifer. Tragacanth

Tragacanth contains from 20–30% of water-soluble fraction called tragacanthin (composed of tragacanthic acid and arabinogalactan). It also contains 60–70% of a water-insoluble fraction called bassorin. Tragacanthic acid is composed of D-galacturonic acid, D-xylose, L-fructose, D-galactose and other sugars. Tragacanthin is composed of uronic acid and arabinose and dissolves in water to form a viscous colloidal solution and bassorin swells to form a thick gel. Tragacanth will partially dissolve and partially swell in water to yield a viscous colloid. The maximum viscosity is achieved after 24 hours at room temperature or after heating for eight hours at high temperatures. The viscosity of these solutions is generally considered to be the highest among the plant gums and is heat and pH stable over a wide range of values.

Caesalpinia spinosa. Tara Gum

Tara gum is a neutral galactomannan with a linear main chain of (1-4) linked D-mannose units to which galactose units are bound (1-6) linking. The thickening effect is similar to guar and locust bean gum.

Cellulose Gum

Most cellulose gums are naturally derived as an unwanted part of the wood pulp process to produce paper. Cellulose is the main constituent in plant fiber. Cotton, for example, is 90% cellulose. Used as a thickening agent and emulsifier, it is widely used in cosmetics, hair and skin care because it swells in water.

Ceratonia siliqua. Locust Bean Gum, Carob Seed Gum

Locust bean gum is obtained from the carob seed or *Ceratonia siliqua*. Carob seed gum is another common name for locust bean gum. The pods are nourishing and contain starch, protein and sugar. The seeds are not unlike cocoa in taste and texture when ground. The pharmaceutical industry uses carob in the preparation of cough linctuses. Locust bean gum and its thickening properties date back to the ancient times and the ancient Egyptians used the paste of locust bean gum as an adhesive in mummy binding.

Chondrus crispus. Carrageenan

Carrageenan is extracted from red seaweeds and available in three distinct chemical forms: *Kappa carrageenans* produce strong, brittle gels, *Iota* carrageenans give soft elastic gels, and *Lambda* carrageenans are non-gelling thickeners. These three forms provide the formulator with a large number of possibilities. Carrageenan can be formulated in very low concentrations to form fluid gels that stabilize solid particles and help suspend them and prevent settlement with time, e.g. foundations, scrubs and toothpastes. The formulator can create rheological profiles ranging from free-flowing liquids to thixotropic fluid gels and self-supporting solid gels by choosing the right form of the gellant.