INTRODUCTION TO NATURAL GRADE

CARRAGEENAN

TUGBONGAN, CONSOLACION 6001, CEBU, PHILIPPINES TEL: +63 32 345-2751 / 345-2749 FAX: TEL: +63 32 345-2740

An Introduction
To Natural Grade Carrageenan

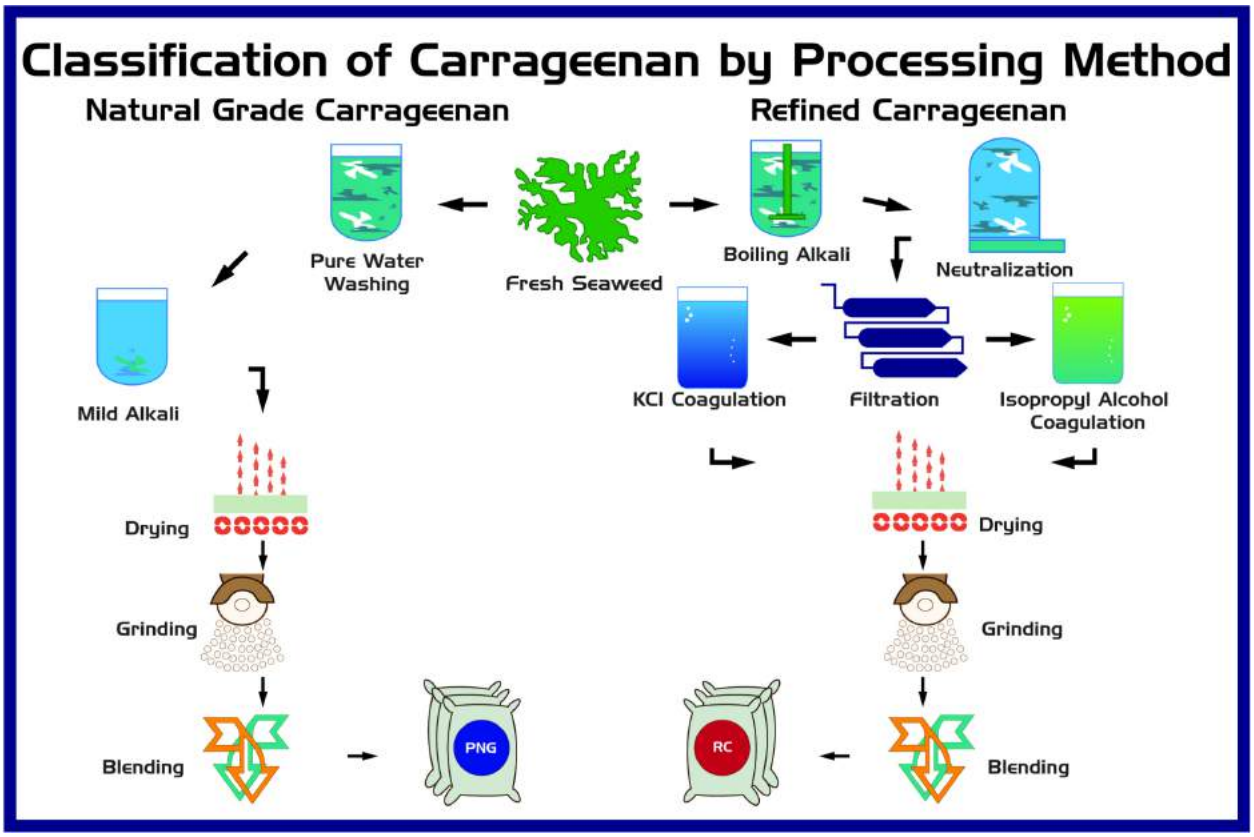
What is Carrageenan?

Carrageenan is a linear sulfated polysaccharide obtained from red seaweeds.

- Has the unique ability to form a wide range of gel texture at room temperature
- Thickens, suspends and stabilizes particulates as well as colloidal dispersions and water/oil emulsions
- Solutions shear thin (providing ease of pumping), but viscosity and suspending ability is quickly restored on standing.

How is Carrageenan Produced?

Commercially, carrageenan may be manufactured through any of three very distinct processes, two of which produce the “Refined Carrageenan” while one gives rise to the “Natural Grade Carrageenan”.



Regulatory Status of Philippine Natural Grade Carrageenan (PNG):

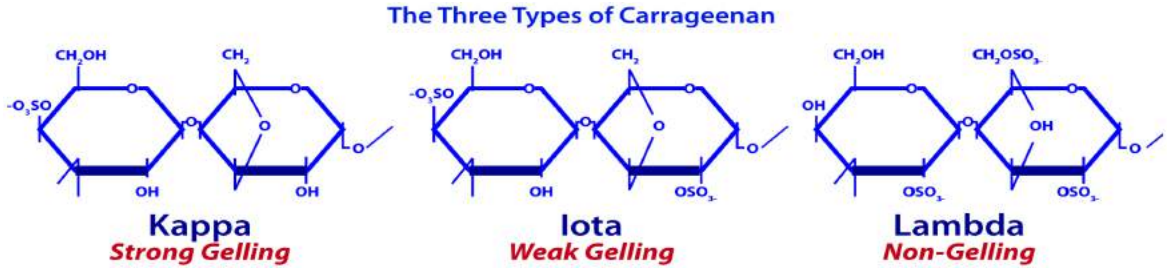
On July 8, 1991, USFDA has confirmed that PNG Carrageenan complies with 21 CFR No. 172.620 and is therefore acceptable for use as food additive for human consumption in the United States.

In 1994, JECFA (Joint Expert Committee on Food Additives) and CCFAC (Coded Committee on Food Additives and Contaminants) in Rome, after conducting respective toxicological assessment cleared PNG as food additive. Consequently, Codex Alimentarius has assigned INS E407a to the product.

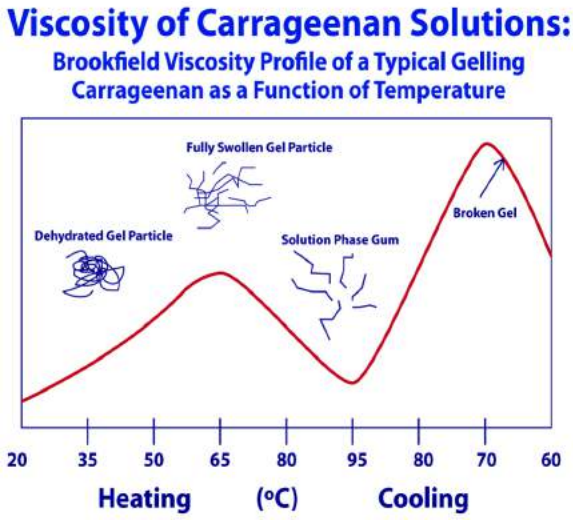
What is the Physical Chemistry of Carrageenan?

Chemical Structure:

Natural Grade Carrageenan consists of linear sulfated polysaccharide of D-galactose and 3,6-anhydro D-galactose obtained from *Kappaphycys spp.* (tradename: Eucheuma cottonii) and *Eucheuma dentriculatum* (Tradename: Eucheuma spinosum) farmed in the coastal areas of the Philippine islands.



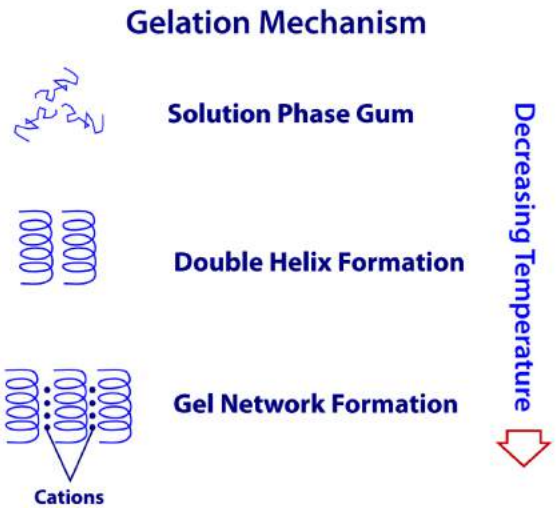
- The different types of carrageenan differ only in the position and number of ester sulfate groups which determine the physical properties (viscosity and gelation characteristics) of the carrageenan.
- The visco-elasticity of the sol and gel phases can be varied to suit almost any application.



- Carrageenan contributes to viscosity development
- Viscosity is a measure of the amount of shearing stress or liquid resistance to flow by a fluid or semi fluid.
- For carrageenan solutions, the measured viscosity is affected by factors such as temperature, presence of cations and degree of gum hydration
- When the carrageenan powder is dispersed in water at room temperature, the particles absorb water leading to swelling and increase in size as the particles start to hydrate.
- With heating, the hydrated molecules uncoil and tend to intertwine with adjacent particles forming a viscous solution.
- As the temperature increases, swelling increases and so does the measured viscosity as the particle becomes fully swollen.
- Further heating eventually leads to complete dissolution of carrageenan which leads to a decrease in viscosity.

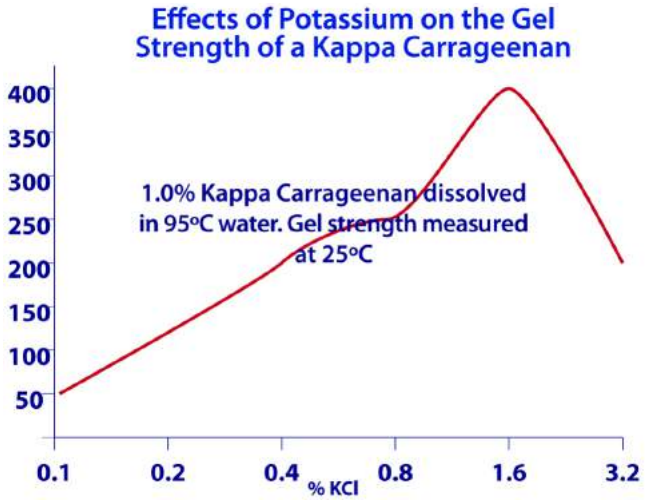
Gelation of Carrageenan:

- At temperature higher than 60ºC, carrageenan exists in solution as a random coil which undergoes a double helix transition as the temperature decreases.
- Gels form when the double helices align to form quasicrystalline regions.
- Requires the presence of cations for alignment.
- Ester sulfate content determines how tightly the helices align.



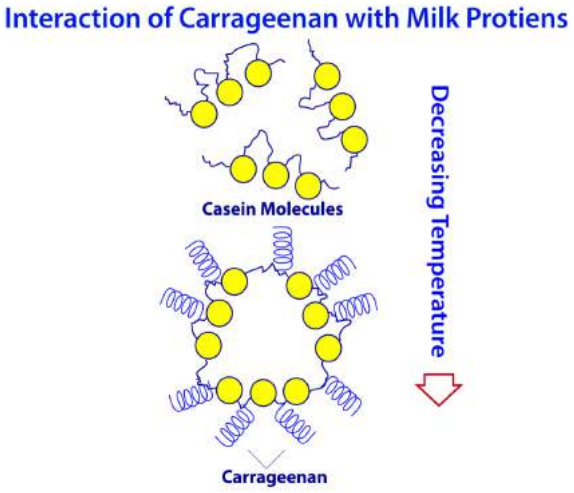
Sensitivity to Cations:

- The ability of carrageenan to form a gel and the characteristics of the gel formed is related to how closely the carrageenan molecules can align to form a quasicrystalline network.
- The presence of ester sulfates tend to keep the molecules apart thus the need for cations to act as a bridge between two molecules.
- The functionality of carrageenan is sensitive to both the type and the concentration of cation.
- Of the 3 types, lambda is the least salt sensitive (lambda is non gelling) and kappa the most. The physics behind is not well defined.
    - Sensitivity to Cations:
        - KAPPA : Na+ << Ca++ < K+
        - IOTA : Na+ << K+ < Ca++



Protein Reactivity:

- Carrageenan is a highly negatively charged macro molecule and has the ability to interact with any species carrying an opposite charge.
- Molecules with positively charged groups (e.g proteins below the isoelectric point) will complex directly with carrageenan without the need for intervening cations.
- Above the isoelectric point, cations are required to form an electrostatic bridge between the protein and carrageenan.

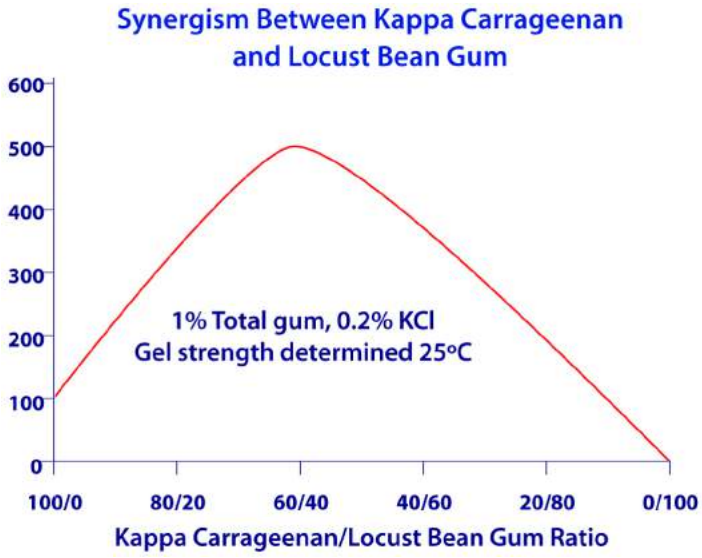


- The details on the interaction depends critically on the stereochemistry of the protein.

- The interaction can lead to:

  The precipitation of the protein

  - The formation of a stable complex or gel structure with interesting and useful properties (e.g. milk / carrageenan)



Compatibility with other ingredients and gums:

- Carrageenan is compatible with all ingredients normally used in the food industry.
- Insensitive to enzymes including cellulase and can be used safely with other gums such as CMC, which are enzyme sensitive.
- Bland with excellent flavor release characteristics.
- The properties of a mixed gum system are generally the sum of the individual components except for a few gums which exhibit a positive synergism with carrageenan.
- Kappa and locust bean gum are synergistic.

Interaction of carrageenan with particulates:

- Carrageenan interacts with finely divided insoluble materials (i.e. calcium carbonate or silica) to give a stable dispersion of the particulates.
- An interaction will take place between carrageenan and any substrate which is either positively charged, has positively charged regions or a positive electrical double layer.
- These interactions are very beneficial for the stabilization of systems containing particulates or other insolubles (i.e. in dentrifice application).

Interaction between carrageenan and polyol:

- All types of carrageenan can be dissolved in water/ polyol mixes.
- The water/polyol ratio required depends on the carrageenan, polyol and ionic environment.
- Carrageenan / polyol systems exhibit unique rheology which can be used to control the stability and organoleptic properties of any preparation containing polyols.
- Iota carrageenan in water/polyol systems form true thixotropes with well-defined yield points.
- Kappa carrageenan in water/polyol systems form gels with a well-defined break point.
- The interaction with polyols has been extensively used in cosmetic and pharmaceutical preparations.

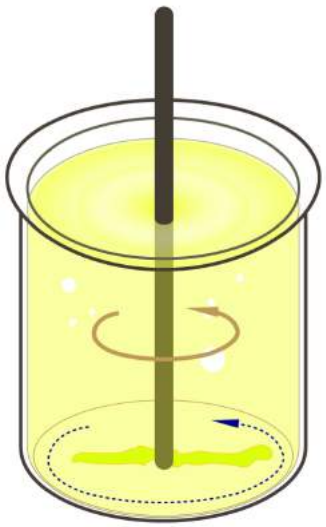
How does Carrageenan compare with other gums?

Gum	Viscosity	Suspension	Gelation	Emulsion Stabilization	Milk/Protein Reactivity
Carrageenan	✓	✓(1)	✓(2)	✓	✓
CMC	✓	✗	✗	✗	✗
Pectin	✓	✗	✓(3)	✗	✗
Gelatin	✗	✗	✓(4)	✗	✗
Xanthan	✓	✓(5)	✗	✓	✓
Alginates	✓	✗(6)	✓(7)	✗	✗
Starches	✓	✗(8)	✓	✗	✗

(1) Carrageenan is produced with specific yield point that can be tailored to a given application. Suspending power depends on choice of carrageenan as well as concentration.
(2) Carrageenan gels in the presence of all common cations, requires no refrigeration and produces a very wide range of texture and mouthfeel.
(3) Pectin, including low-methoxy pectin, requires sugar for gelation.
(4) Gelatin requires refrigeration for gelation and cannot provide a range of texture. It is not kosher.
(5) Xanthan suspends and its suspending power can be increased only by increasing gum concentration.
(6) Propylene glycol alginate solutions have a yield point and it will therefore suspend particulates. However, there are considerable concerns over the safety of derivative alginate.
(7) Alginates require calcium for gelation and have limited range of texture and mouthfeel.
(8) Starches suspend by viscosity alone. Starch gels are pasty in texture and mask flavor.

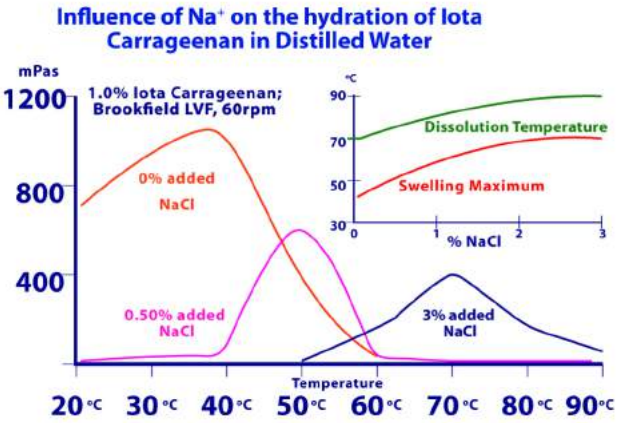
How is Carrageenan used?

- Carrageenan is unlike salt or sugar which simply dissolves if added to water.
- Carrageenan powders are composed of finely ground dehydrated gels which must swell before dissolution can take place.
- The dehydrated gel fragments are hard and completely non-tacky.



Dispersion Techniques:

- Partially swollen materials become very sticky. It is thus essential to ensure that efficient and proper dispersion is effected before appreciable swelling occurs.
- This is accomplished easily by dry blending the carrageenan with the other dry ingredients or by wetting with polyol before addition to water.
- If carrageenan is to be added directly to water, it should be added to the vortex of a well-stirred system.
- If the system allows, never add carrageenan to hot water



Hydration of Carrageenan:

- The hydration of carrageenan is critically dependent on the ionic environment.
- Addition of salt decreases cold swelling.
- As the concentration of added salts increases, the cold swelling decreases and the temperature required to completely solubilize the gum increases.

Process Considerations:

- Carrageenan systems require heating to achieve optimum utilization unless the carrageenan blend is designed for cold functionality.
- In meat systems where low viscosity solutions are required for pumping purposes, carrageenan is dispersed after the salts have been dissolved to inhibit swelling of the particle and to prevent clogging of the syringe.
- If the desired product is in a gel state, as in dessert gels, the gel matrix should not be disturbed during cooling so as not to disrupt the gel formation.
- For suspension applications such as salad dressings or marmalades, gentle shear of the system during cooling may be used to improve the texture of the product and create body.

- For low pH processing, such as juices or tomato sauce, carrageenan should be added at the end of the cooking cycle with fast cooling to prevent degradation in acidic medium.

Stability of Carrageenan Powder:

- Carrageenan powders contain 8-10% moisture, most of it bound to the molecule. It does not absorb moisture from the atmosphere or cause other ingredients to cake.
- The dry powder may be stored for a year or more under standard warehousing conditions without deterioration or loss in quality so long as it remains dry.
- Unlike other gums, carrageenan is insensitive to other enzymes, especially cellulase.
- In both gel and solution form, food preservatives must be added to prevent bacterial contamination which may cause fermentation and eventually, the degradation of the carrageenan.
- However, aseptically packed products do not require preservatives.
- Carrageenan is highly stable in boiling neutral or alkali solutions without loss in viscosity or gel potential.
- In acidic systems, carrageenan solutions are susceptible to viscosity losses specially at high cooking temperature.
- In gel form, carrageenan is stable even at low pH .

MCPI CARRAGEENAN : Product Directory
FOOD APPLICATION

Foodgel®Series	APPLICATION	FUNCTION	USAGE LEVEL
MEAT, FISH, AND POULTRY			
BM	Batter Mix for Tempura & Fried chicken	Improves the viscosity and cling of the batter. Prevents water separation of the batter during pre cooking stage.	1.00 – 1.50 % by total weight of the dry mix.
Ba	Bacon	Holds moisture and minimizes weight loss during storage and cooking. Reduces shrinkage.	0.50 – 0.70
BP	Beef Patty	Replaces fat. Binds moisture for tender and juicy patty. Minimizes weight loss during freeze thaw and cooking	0.40 – 0.50
CB	Chicken Burger	Improves binding strength. Holds moisture and makes chicken burger more tender and juicy	0.80 – 1.00
CN	Chicken Nugget	Retains moisture for tender and juicy chicken nuggets. Minimizes weight loss during freeze thaw and cooking	0.80 – 1.00
CPP	Crispy Pork Pata	Controls dehydration in crispy pork pata Promotes good sliceability Enhances juiciness when cooked	0.30 – 0.50
GC	Coating for Food	Forms a glossy, easy to peel gel coating Reduce moisture loss and delay lipid oxidation during cold or frozen storage Gel matrix serves as a carrier for anti-oxidants or preservatives	0.80 – 1.20
FB	Fish burger	Improves binding strength Holds moisture to make fish burger more tender and juicy Prevents freeze thaw syneresis	0.80 – 1.00
	Fish Loaf	Binder for minced fish meat Improves texture Reduces shrinkage and purging of meat juices	0.20 – 0.50
	Tuna Burger	Improves binding strength. Holds moisture to make tuna burger more tender and juicy Prevents freeze thaw syneresis	0.80 – 1.00
	Tuna Tocino	Binds meat and moisture for tender and juicy tocino Improves texture Reduces shrinkage and purging of meat	0.07 – 0.09

		juices	
HP	Ham	Holds moisture to minimize weight loss during storage and cooking Binds structured ham Promotes good sliceability	0.50 – 0.70
HG	Ham glaze	Gives a glossy and attractive finish to ham Promotes good sliceability	1.00 – 3.00
MB	Meatgel, sausage, corned beef, longanisa, chorizo, mortadella	Serves as meat extender Improves binding strength Prevents fat separation. Increases yield	0.30 – 0.50
	Ham	Holds moisture to minimize weight loss during cooking and storage Binds structured ham Promotes good sliceability	0.50 – 0.70
	Surimi	Improves gel forming ability of surimi Improves elasticity Prevents freeze-thaw syneresis Prevents formation of large crystals	0.30 – 0.50
	Tapa and Tocino	Serves as meat extender Increases yield Improves texture Binds moisture for tender and juicy tapa & tocino	0.50 – 1.00
	Embutido, Siomai & other similar products made of comminuted meat	Serves as meat binder and extender Improves binding strength. Prevents fat separation. Prevents weight loss due to freeze thaw. Provides juiciness to taste	0.50 – 1.00
PP	Poultry	Controls dehydration in frozen poultry Prevents freezer burns Promotes good sliceability Enhances juiciness when cooked	0.30 – 0.50
SB	Seafood Analogue	Improves elasticity in extended seafood analogue. Prevents weight loss due to freeze-thaw syneresis	0.50 – 1.00
DAIRY			
CHI	Cheese	Increases yield. Contributes to the formation of a hard curd Improves textural properties	0.05 – 0.10
CNM	Processed coconut milk	Prevents water separation Maintains a homogeneous mixture Improves viscosity	0.30 – 0.50
CMD	Chocolate milk drink	Gives body and stability to chocolate milk drink	0.03 – 0.08
	Instant Chocolate Milk Drink	Gives body to instant chocomilk drink Suspends cocoa particles	0.03 – 0.08 % by total weight of chocomilk drink

	Coffee	Coffee stabilizer Improves body of coffee drink	0.03 – 0.08 % by total weight of coffee mix
IC	Ice cream	Prevents formation of large ice crystals Maintains a homogeneous mixture Enhances excellent flavor release	0.60 – 0.80
	Frozen novelties	Acts as an emulsifier and stabilizer Retards melting Prevents formation of large ice crystals	0.40 – 0.60
MS	Milk stabilizer	Stabilizes milk system Prevents water separation	200 – 300 ppm
DESSERT & CONFECTIONERIES			
CD	Gummy candy	Forms a soft chewy gel-like candy	0.90 – 1.10
CMS	Chocolate mousse	Gives smooth, uniform texture and provides excellent flavor release Enhances desirable mouth feel	0.30 – 0.50
DG	Dessert gel	Forms a glossy, easy to unmold dessert gel	0.50 – 1.20
	Gummy Candies	Forms a soft to chewy gel-like candy	0.90 – 1.25
FL	Flan & Pudding	Provides the basic smooth gel texture Enhances excellent flavor release and good mouth feel	0.50 – 0.80
M	Marmalade	Prevents water separation and gives body	1.50 – 2.00
PB	Peanut butter	Prevents oil separation during storage. Improves spreadability	0.20 – 0.60
SJ	Piping Jelly or Squeeze Jelly	Forms a glossy and manageable jelly for cake decoration.	5.00-7.00
BAKERY			
IA	Gum Paste	For smooth, elastic, and easy to knead gum paste.	0.10 - 0.30
BS	Hot Cake Mix	Stabilizes batter for prolonged standing time Imparts a fine texture to hot cakes Provides body to the batter preventing a run down during cooking, thus obtaining a perfect round mold	0.30 – 0.60
BRD	Bread	Increases yield Improves texture and mouth feel of breads	0.20 – 0.60
BRG	Bread glaze	Provides gloss to bakery products without affecting the taste	0.50 – 1.00
CK	Cake / Icing	Partial replacement of shortening in cakes Delays onset of melting in icing	0.20 – 0.30
CKG	Cake glaze	Gives a transparent gloss to cakes Minimizes moisture loss resulting to prolonged storage	0.50 – 1.00

NOODLES & PASTA

NDB	Noodles (instant, steamed, boiled, dried, fried) and Pasta	Improves the resistance of noodles and pasta to breakdown during cooking Increases water binding capacity of wet noodles Increases rate of extrusion Gives the product a superior polished surface	0.20 – 0.70

SAUCES AND DRESSING

K	Catsup and Sauce	Improves viscosity. Controls water separation.	0.08 – 0.20
SST	Sardine sauce	Thickens and improves the sauce texture Prevents fat and water separation	0.50 – 1.00
SD	Mayonnaise / Fat reduced Mayonnaise	Stabilizes the oil emulsion Replaces the vegetable oil for a fat reduced system	0.50 – 1.00
	Salad Dressing / Fat reduced salad dressing	Stabilizes the oil emulsion Replaces the vegetable oil for a fat reduced system	0.30 – 0.60
ST	Syrup	Thickener for syrup	0.10 – 0.25
WC	Cream	Cream emulsifier / stabilizer	0.30 – 0.50
MJ	Milk juice	Suspends fruit pulp without settling over prolonged storage	0.04 – 1.00

JUICES AND BEVERAGES

JC	Fruit juice and concentrate	Prevents water separation in fruit juices and concentrate	0.03 – 0.07
	Jelly juice	Provides a very soft gel matrix to jelly juice	1.00 – 1.25
SCM	Instant coffee or chocolate milk drink	Gives body to instant coffee or chocolate drink Suspends cocoa particles	0.03 – 0.08 % by total weight of coffee or chocomilk drink.
	Health Food Supplement	Provides body to instant health drinks Suspends cocoa, corn and soya particles Provides dietary fiber	0.30 – 0.90

NON-FOOD APPLICATION

Eugel®Series	APPLICATION	FUNCTION	USAGE LEVEL
AFG	Air freshener gel	Forms a solid gel with controlled rigidity upon cooling Controls evaporation to ensure stable fragrance release for longer period of time Controls syneresis during long shelf storage	0.08 – 1.00
C5	Sugarcane juice	Acts as floculant in sugarcane juice clarification Serves as settling aid in the sugar industry	5.00 – 10.00 ppm
CLRM	Beer	Accelerates and improves wort clarity	30.0 – 60.0 ppm

CM	Plant embryo and tissue culture media	Provides a gel matrix for culture media	0.70 – 0.80
INDUSTRIAL			
CMT	Concrete Cement	Improves compressive and flexural strength of cement. Slows down curing allowing convenient transport Prevents air entrapment Provides a smooth, even finish to concrete surface	
DF	Drilling Fluid	Forms a wide range of gel networks and viscosity that can support in suspending soil, sand and cuttings at a pumpable consistency. Improves gel formation in the presence of calcium and potassium salts.	2.0 - 3.0
DSP	Paper	Provides dry strength Creates a thin film that binds and cements fibers Reinforce cellulose fibers to give added wet and tear strength	1-2% solution, 2.5-5 kg per ton dosage
FFG	Fire fighting Gel	Forms a protective water gel layer which can absorb more heat than air filled foams Has the ability to stick and coat materials	1 – 2 % by total weight if dumped using helicopters 0.50 – 1.00 % by total weight if sprayed using fire trucks
FLEXITEX	Textile/Printing Ink	Thickens the printing paste Improves color yield Gives sharp lines without bleeding Reduces printing cost	1.00 – 2.00
PM	Paper Marbling	improves viscosity of the size	0.2 - 0.5
PNT	Paint	Promotes quicker drying time. Enhance color definition. Add thickness to help paint spread evenly. Wide range of area coverage.	
STK	Corrugated Box Adhesive	Partial or full replacement of starch Improved adhesion	0.40 - 0.60 % by total weight if partial replacement 1-3% by total weight if full replacement
SUPRATEX	Textile/Printing Ink	Thickens the printing paste Improves color yield Gives sharp lines without bleeding Reduces printing cost	1.00 – 2.00

FS	Fungicide - micronutrient mixture	Stabilizes fungicide – micronutrient mixture to provide a homogeneous solution during spraying	0.20 – 0.40
PERSONAL CARE			
FC	Face Cream with Aloe Vera and Lactoceramide (O/W)	Forms a cream gel with controlled rigidity Enhances moisturizing and nourishing properties for a longer period of time Stabilizes the cream system to prevent water separation Suspends active ingredient and control stable fragrance release	0.50 – 1.00
FLEXI	Hand and Body Lotion	Thickener and stabilizer for hand and body lotions Helps retain moisture	0.09 - 0.12
FM	Facial Mask	Acts as a gel base for exfoliating, hydrating or cleansing ingredients	1.00 – 1.50
HS	Hand sanitizer	Acts as a gel base Leaves a light film to minimize drying of hands	0.20 – 0.40
SHI & SHK	Hair shampoo	Increases viscosity Stabilizes oil / water mixture	0.30 – 0.80
TP	Toothpaste	Gives body to toothpaste Stabilizes toothpaste system to prevent water separation Suspends abrasive to prevent settling at the toothbrush base Increases rinsing capability	0.80 – 1.20
PETFOOD			
FMB & Type G	Canned fish and meat	Acts as petfood binder Prevents water and fat separation Gives sheen to enhance appetizing quality	0.50 – 1.50
PFB	Pelletized feed	Binds pelletized feed ingredient	1.00 – 2.00

CUSTOM BLENDS OR FORMULATIONS:

MCPI experts will also formulate blends of carrageenan types to give exactly the right degree of gelling, stabilizing and binding needed to make your product of the highest level of quality.

LIMITED WARRANTY

MCPI Carrageenan is sold with the understanding that the purchasers make their own tests to determine the suitability of the product for their particular purpose and processing conditions.

Tugbongan, Consolacion 6001, Cebu Philippines

CONSUMER LINES

Dehydrated Seaweed

Dried Seaweed, Eucheuma spinosum, locally known as “guso” or “gulaman”. The dehydrated seaweed is hygienically washed and dried to ensure food safety. It may be rehydrated for making seafood salad. It could also be finely ground to be used as filler for different types of food preparation.

Ready Mix Dessert Gel

All natural, healthy, easy to prepare dessert gel ready mix powder. Can also be used to prepare flans, and puddings.

McHenry’s Food Supplement

Health Food supplement is a concoction of high energy and high fiber natural food for health conscious individuals. It is fortified with seaweed powder of the Eucheuma sp., rich in soluble fiber which normalizes bowel function and can have cholesterol-lowering and hypoglycemic effects as well as some anti viral activity.

SEAWEED Vigor
Seaweed based Food Supplement for Men

Long believed to have potent aphrodisiac properties, seaweed of the Eucheuma sp., is a rich source of macronutrients which primarily provide the body with energy as well as trace elements essential for normal body functioning. It is rich in soluble fiber fraction which normalizes bowel function and can have cholesterol lowering and hypoglycemic effects. Aside from these, Eucheuma sp. was found to inhibit both HSV1 and HSV2 (virus causing genital herpes) and demonstrated to have some anti-viral activity including HIV.

THE COMPANY

MCPI Corporation is a Filipino company engaged in the manufacture of quality alternatively refined Natural Grade Carrageenan specifically designed for the food and non-food industries. MCPI is a pioneer in seaweed cultivation in the Philippines and also one of the major suppliers of seaweed raw materials to worldwide carrageenan processors.

MCPI owns and operates to full capacity, a modern plant facility in a 3-hectare area at Tugbongan, Consolacion, Cebu which produces carrageenan at an annual rate of 1,500 MT with provisions for expansion to 3,000 MT yearly. MCPI has an aggressive and strong raw material buying network complemented with continuing farm development program in many areas of the Philippine Archipelago.

Likewise, MCPI maintains the only ocean farming research and training center in its seaweed farm concession in Danajon Reef in Central Visayas which includes studies of *Eucheuma* polyculture with other marine species such as abalone and *Tridacna* (Giant clam).

Our Mission... Our Vision...

MCPI Corporation acknowledges Jesus Christ as the Lord guiding us to attain our goals as we adopt Christian principles in all endeavors toward achieving our objectives, making us a visible sign of His peace and glory.

MCPI promotes the family as the cradle of value formation of individuals that are responsive to the needs of his fellowmen, community and nation.

MCPI respects the bounty and paramount importance of nature and is committed to utilize only environment-friendly processing systems that produce total quality products, consistently meeting customers' need for excellence, cost competitiveness, and timely delivery.

MCPI provides employees and associates an environment of open communication, opportunities for personal career growth, talents and gift development in the light of Scriptural values where honesty, trust, confidence and understanding are fostered; promotes love among each other and respect for individual differences while encouraging one another to devote total commitment to excellence in performing respective duties and responsibilities.

MCPI upholds the importance of its partnership with customers, suppliers and service providers while promoting the interest of stockholders and increasing company assets.

Santo Niño de Cebu

GOOD MANUFACTURING PRACTICES GMP CERTIFIED FDA

HALAL حلال IDCP ISLAMIC DAWAH COUNCIL OF THE PHILS.

MANUFACTURING PLANT AND HEAD OFFICE
Bgy. Tugbongan, 6001 Consolacion, Cebu, Philippines
Tel: +63 32 345-2751 / 345-2749 Fax: +63 32 345-2740
Email: info@mcpicarrageenan.com
URL: www.mcpicarrageenan.com

MANILA SALES OFFICE:
42 United Nations St., Betterliving Subd.
Parañaque City, Metro Manila, Philippines
Telefax: +63 2 821-9053 Tel: +63 2 +63 2 516-4283
Email: mcpi_mnl@yahoo.com.ph

USA OFFICE:
American Carrageenan Technology Systems, Inc.
Waldport, OR 97394-0023
Tel: +1 541-272-3039 Fax: +1 541-563-2659
Email: AmericanCarrageenan@gmail.com / info@actsinc.biz
URL: www.actsinc.biz

MCPI CORPORATION