

Chocolate Milk

BVR-07

Functions of Marine Colloids™ Carrageenan

- Suspends cocoa
- Adds viscosity
- Contributes body and mouthfeel

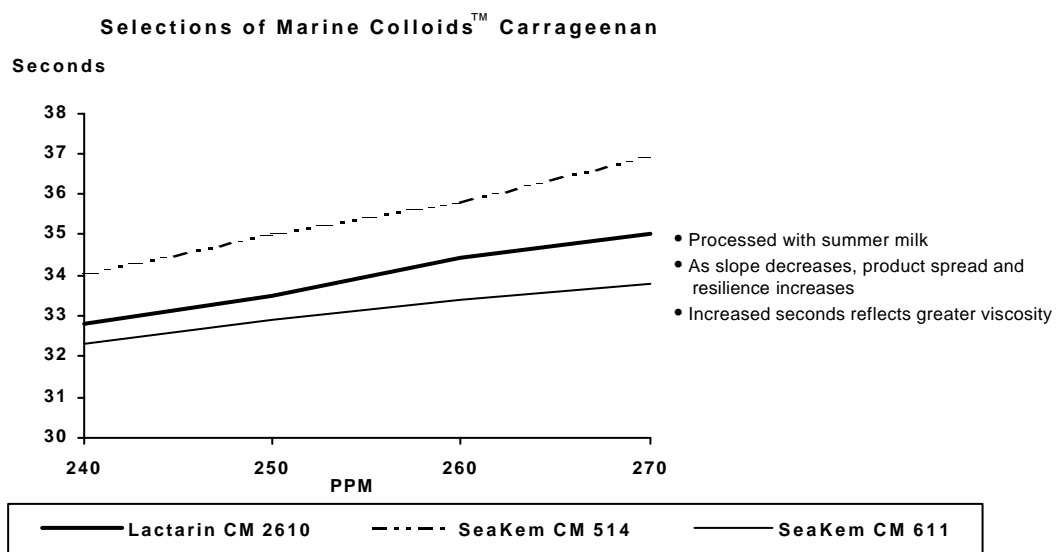
Comments

The matrix of SeaKem® carrageenan products for chocolate milk stabilization are designed to provide a range of stabilizer characteristics depending on desired finished chocolate milk properties. Each product is standardized for milk index strength giving uniform suspension and viscosity in chocolate milk.

Resilience of the chocolate milk system depends on the carrageenan system offering superior spread characteristics. Spread as measured by the milk index text, is the use level that suspends cocoa yet does not gel or create - blurb when poured. Spread is a characteristic which defines the optimum use levels of the carrageenan. The wider this use level range, the wider the spread and the more resilience the product possesses.

The matrix of products include SeaKem® CM 611 carrageenan, SeaKem® CM 514 carrageenan and Lactarin® CM 2610 carrageenan. Performance in the milk index test is presented on the table below.

- Greatest resilience is provided by SeaKem® CM 611 carrageenan
- Greatest viscosity is provided by SeaKem® CM 514 carrageenan
- SeaKem® CM 2610 carrageenan offers both these characteristics in moderation plus greatest economy



Formulation

<u>Ingredients</u>	<u>% by Weight</u>
2% milk	89.895
Sucrose	5.930
Water	3.350
Dutched cocoa	0.800
Marine Colloids™ carrageenan*	<u>0.025 - 0.040</u>
	100.000

* FMC BioPolymer

Procedure

- Dry blend cocoa, sucrose and carrageenan then add to milk.
- If liquid sugar or corn syrup is used, meter into batch.
- Add dry blended ingredients.
- Pasteurize by batch, HTST or UHT heat processing techniques.
- Cool to 4°C (40°F) and fill. If liquid sugar or corn syrup is used, meter into batch.

Discussion

Chocolate flavored milk is manufactured in dairies primarily with hot process dairy powder base mixes. Hot process dairy syrups are also available but their use is limited. At the dairy, sweetener is added to the base mix and combined with raw milk to process the finished chocolate milk under appropriate pasteurization and homogenization parameters. The hot process base mixes contain carrageenan which functions to:

- Suspend the cocoa
- Contribute body and mouth feel
- Stabilize the fat and inhibit creaming

Carrageenan is a unique hydrocolloid stabilizer for dairy applications because of its ability to react predictably with milk proteins to permanently suspend cocoa at appropriate use levels and storage conditions. Products such as starch and guar gum may be included in base mixes as auxiliary thickeners but the cocoa suspension contributed by these components is only viscosity related and thus temporary.

Chocolate milk is typically processed under HTST pasteurization conditions. UHT pasteurized products are also available and will become more significant as the trend toward greater convenience continues. Batch pasteurization is observed infrequently in the field and occurs generally in dairies with older processing equipment.

Discussion (continued)

Production of chocolate milk is affected by many variables which differ from dairy to dairy. A generally uniform finished product is produced over a wide geographical market segment by minimizing the various parameters which inherently differ between dairies. Factors affecting finished chocolate milk quality include:

- Source of milk
- Butterfat level in milk
- Variation in protein content of the milk
- Cocoa formulation
- Total heat exposure during pasteurization
- Cooling method and temperature off the cooling unit
- Stabilizer source
- Shear stress due to processing equipment

The mechanism by which carrageenan imparts its unique functionality to chocolate milk is thought to be due to both the water gel and milk gel potential of the stabilizer. Since milk is composed of about 87% water, there is ample opportunity for carrageenan-carrageenan helix formation after pasteurization and during the cooling phase of production. Additionally, the 3.3% protein in milk as well as protein contributed by the cocoa allow for carrageenan-protein interaction. Data indicates that cocoa suspension is due to the water gel potential or carrageenan-carrageenan interaction. The suspension is due to the rapid formation of a weak gel matrix which entraps the cocoa particles during the cooling phase of production. Protein-carrageenan interactions account for the viscosity development, mouthfeel and body of the finished chocolate milk. This interaction progresses with time and maximum viscosity development is attained within 24 hours.

Chocolate Milk Terminology

In order to evaluate stabilizer systems and to maintain a consistent quality control program, a clearly defined screening system must be implemented with accompanying terminology. A review of basic terms necessary for quality control is as follows:

Milk Viscosity - Represents viscosity of the finished chocolate milk and is directly related to the flow characteristics. Viscosity can be measured in terms of time (secs) of flow through a flow meter under given conditions of temperature, milk supply and diameter of the orifice. Alternatively, viscosity can be measured using one of several commercially available viscometers; viscosity is reported in centipoise (cp = mPa.s).

Milk Index - Represents a measure of relative strength between two stabilizers. Milk index is reported in ppm of carrageenan required to equal viscosity of a control sample which is used to control daily variability in the milk supply used for testing. Milk Index is determined through linear regression analysis of a plot of finished milk viscosity (Y axis/logarithmic) versus carrageenan use level in ppm (X axis/linear).

Use Level - Refers to the amount of carrageenan (ppm) required for desired stabilization and organoleptic properties. The recommended use levels are normally in the 250-400 ppm range, although the type of carrageenan system used more clearly defines optimum use levels. Use level for this bulletin refers to the amount of carrageenan relative to weight of milk used rather than on total weight.

Spread - A characteristic which defines the usable range of a stabilizer under optimum conditions; that is, where there is no evidence of understabilization or overstabilization. Spread characteristics are given in ppm of carrageenan.

Understabilization - A condition characterized by incomplete suspension of cocoa particles (settling and dusting), as well as a gradient of color in the finished product with the darkest cocoa color at the bottom of the container. Understabilization is most often associated with carrageenan use levels which are too low. However, the type of carrageenan and composition of the milk can contribute to this condition.

Overstabilization - A condition in which interaction of carrageenan with the water and protein phases of the milk source interferes with flow properties. The interactions result in a localized gel formation or blurb, as well as unappealing sensory characteristics. Trapped air and whey-off may also be observed.

Screening Tests

The ability of carrageenan to function in chocolate milk systems can best be estimated by a laboratory scale production of finished product. Once prepared and evaluated, parameters such as milk index, spread, cocoa suspending ability and viscosity can be determined. At this time, performance differences between carrageenan samples can be evaluated.

Methods of heating, cooling, storage and viscosity determination vary with individual laboratory preference and access to equipment. It is a matter of personal preference as to what procedures are best for evaluation carrageenans. Although individual preferences may differ considerably, the following formulation is used at FMC BioPolymer in the test QCP 30000.

<u>Component</u>	<u>Percent</u>	<u>Weight (g)</u>
2% fat pasteurized milk	89.46	670.0
Sucrose	5.93	44.5
Water	3.35	25.0
Dutch cocoa	<u>1.26</u>	<u>9.4</u>
	100.00%	748.9g

Test Procedure

- Dry blend ingredients and add to milk with agitation.
- Heat in controlled bath 74°C (165°F) for 3 minutes with agitation.
- Add back water lost due to evaporation.
- Cool to 10°C (50°F).
- Store in water bath at 10°C (50°F) for 24 hours.
- Make observations and determine viscosities with Zahn flow meter.

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REGULATORY STATUS:

Carrageenan "chondrus extract" is generally recognized as safe [GRAS] (see 21 CFR 182.7255) by experts in accordance with FDA food and drug regulations. Carrageenan is approved as a food additive under 21 CFR-172.620. All products manufactured by FMC BioPolymer meet all standards of quality as defined by:

- Food Chemicals Codex III
- J.E.C.F.A. Specifications issued by FAO/WHO
- European Economic Community Directives

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TECHNICAL SERVICE:

The information contained in this bulletin is intended to be general in nature. Techniques and data pertaining to specific uses for FMC ingredients and new developments will be published periodically in the form of supplemental application bulletins.

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