Application Bulletin

FMC BioPolymer

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Flans and Custards Prepared From Dry Mix Base

GEL-09

Benefits of SeaGel® Carrageenan-based Flans

- Excellent flavor release and pleasing mouthfeel
- Uniform results from one preparation to the next
- Efficient and economical substitute for egg-based flans
- A wide variety of flans can be produced, each tailored to specific requirements, e.g., strength, resiliency, syneresis control, texture, and mouthfeel
- Refrigeration not essential for gelation
- May be marketed in a ready-to-eat form generally distributed in a dairy case

Comments

In the U.S. it may be referred to as a custard or a flan, in Europe the French call it creme caramel and in Latin America it may be called "temblique". Wherever the location, the terms are used to describe a sweetened, flavored mixture of beaten eggs and milk which is cooked over hot water or baked in an oven. Coagulation of the egg protein during cooking produces a gelled structure. After cooling, the product may readily be unmolded.

FMC BioPolymer offers a range of carrageenan products ideally suited for replacing eggs as the setting agent in flans and custards. In this bulletin, for the sake of simplicity, we will use the word flan to designate these products.

Very frequently, a caramel sauce is first poured into the mold prior to the milk and egg mixture. Even though the latter is initially thin, the high viscosity of the caramel sauce limits excessive mixing. After baking and cooling, the custard or flan is unmolded. The caramel sauce flows over the product producing an eye-appealing and tasty dessert.

Formulation

Dry Mix Base Ingredients	% by Weight Dry Mix
Sucrose	98.0 - 99.0
SeaGel® carrageenan*	1.0 - 2.0
Color/flavor	To Suit
	100.0

* See Table 1 for specific SeaGel carrageenan and recommended use levels. Percent use level is based on 60 grams dry mix base.

Procedure

- Spoon stir 60 grams of dry mix base into a saucepan containing 500 mls. cold milk.
- Heat the slurry to a boil in approximately 5-7 minutes while constantly stirring.
- Pour the hot solution into desired molds.
- Cool the flan either with refrigeration or at room temperature.

NOTE: The following conditions may effect the textural properties of the end product.

Cooking Time - Longer cooking evaporates more water and gives a somewhat firmer body. A two minute boil of 500 mls. of milk can evaporate 10% of the water.
Molding - Molds may vary from custard cups to one-half liter containers to trays. When flans with sauce are prepared, the molds are first lined with the sauce (i.e. caramel, chocolate).
Cooling - Refrigeration is not essential for carrageenan-based flans to gel; however, they may be refrigerated if desired. A refrigerated flan will be firmer than a non-refrigerated flan.

Table 1: Characteristics of Flans Made With Various Marine Colloids™ Carrageenan

Product	Typical Use Level gms/500 ml Milk	Flan Characteristics
SeaGel® GP 713 carrageenan	1.00	Very brittle gel Smooth, egg custard texture Moderate syneresis
SeaGel FL 674P carrageenan	1.30	Elastic gel Cohesive, chewy texture Very low syneresis
SeaGel FL 644L carrageenan	1.30	Slightly elastic gel Cohesive, chewy texture Low syneresis

Flan Strength Comparison of SeaGel Carrageenan

The maximum gel strength and minimum syneresis are obtained when the cooling rate is slow, such as cooling at room temperature or in a refrigerator. Immersing the molds in a refrigerated water bath can result in a flan with greatly reduced gel strength, e.g., as much as one-half. Once a correlation has been established between slow cooling and rapid chilling, the latter serves as an excellent in-plant procedure, however, is definitely not recommended for development work.

Discussion

The requirements for flans vary widely from country to country, from market to market, and from customer to customer.

Contents of packets of dry blended ingredients, intended for one-half liter (500 ml) of milk, generally range in weight from 50-80 grams. In some countries, small packets containing about 5-15 grams are sold. These contain the gelling system, coloring and flavoring, and require the customer to add the bulk of sugar.

Milk - Being a major ingredient has a great influence on flan characteristics such as strength, syneresis, etc. For example, fluid milk is natural milk that has not been reconstituted. It may range from fluid skim milk (0.5% fat) to low fat milk (1-2% fat) to whole milk (3-5% fat). In some parts of the world, whole milk is homogenized whereas in other parts it is not. All of these factors may affect flan strength, syneresis, or other properties.

Reconstituted milk is used in many parts of the world where fresh milk is not available. As a result, milk solids are reconstituted either in a dairy or at home by the consumer. The type of milk solids used, e.g., low heat or high heat, may affect flan characteristics. High heat milk powders contain more denatured protein than low heat milk powders and can create more problems with regard to whey separation. The flan strength obtained with reconstituted milk is generally lower than with fluid skim or whole milk and syneresis is higher. Also when milk solids are reconstituted with very hard water, the flan may be affected. This will be discussed in detail in a later section.

In certain markets it is desirable to make a dry mix which contains milk solids for reconstitution with water. The same considerations as previously mentioned, such as type of milk solids and hardness of water, should be taken into account and proper adjustments made in the gelling system. For example, if it is known that the mix will be used in very hard water, an appropriate amount of calcium and/or magnesium precipitating or chelating agent may be used.

While cow's milk is most widely used, goat's milk or other types may be employed in various parts of the world. The behavior of the gelling system may best be determined by actually making up flans with the particular type of milk.

Gelling System - The gelling system and the milk have the greatest influence on the body and texture of the flan. There are many variations possible in the gelling system, such as those listed below:

- A particular type of carrageenan.
- A combination of carrageenans.
- Carrageenan plus locust bean gum. The synergistic action of locust bean gum and kappa carrageenan produces a more resilient structure with reduced syneresis.
- Carrageenan plus starch. Cornstarch is most widely used when it is desired to produce a creamier flan. The higher the level, the creamier and more pudding-like the structure. Starch also serves to reduce syneresis.

Phosphate addition - The addition of sodium hexametaphosphate to a product such as SeaGel® GP 713 carrageenan was first taught in FMC BioPolymer's U.S. Patent 3,443,968, now expired. When used at equal levels with SeaGel GP 713 carrageenan, i.e., 1.0 grams/500 ml milk, the flan becomes much less brittle and syneresis is substantially reduced.

Starch - One of the earliest Marine Colloids™ carrageenan products used for flan preparations was SeaGel® GP 713 carrageenan and it is still widely used. As shown in Table 1, this product tends to produce a very brittle gel with moderate syneresis. While this is desirable to many customers, there are those who prefer a less brittle gel with reduced syneresis, which may be provided by using SeaGel GP 713 carrageenan at a 1.0 gram level mixed with some cornstarch. The recommended level of starch is from 2-5 grams/500 ml milk. The higher the starch level (especially above 6 grams), the more the flan assumes a pudding-like consistency and the more the chances of scorching during the cooking process. For the majority of the products shown in Table 1, starch is optional.

Reconstituting milk in hard water - There are many parts of the world where fluid skim milk is not available and where it is common practice to use milk powder for reconstitution. It is often the case that hard water is used for the preparation of the milk and this may seriously affect a flan prepared from a dry mix. For example, if the calcium in the water exceeds 200 ppm, the flans prepared with most conventional gelling agents will exhibit severe whey separation.

Alternate preparation procedures - This procedure is offered where some loss in gel strength and syneresis control can be accepted in favor of obtaining a much faster setting time. It is based on dispersing the dry ingredients into one-half the total quantity of milk, bringing it to a boil with agitation as usual, removing from heat and then adding the balance of the milk. Depending upon the temperature of the cold milk, which may range from refrigeration to room temperature, the mix will be quickly cooled. The temperature of the flan is still above its gelling temperature; however, the mix will start to gel much more quickly than a flan prepared with all hot milk. The quick chilling tends to reduce gel strength and increase syneresis but does speed up the preparation.

Test Procedure for Standardization

All of the FMC BioPolymer products designed for flans are controlled for a variety of characteristics, thus insuring uniformity to the customer from shipment to shipment. The controlled characteristics, details of which are available upon request, are as follows:

Gel Strength - The force in grams required to rupture a flan using a Marine Colloids gel tester. Results are compared with a control, thus eliminating differences that might arise due to variations in the milk source such as seasonal, processing, etc.

Bloom - The force in grams required to force a plunger 4 mm into a flan. Results are compared with a control.

Syneresis - The percent of liquid released from an unmolded flan in a given period of time. Results are compared with a control.

Appearance, Mouthfeel, Flavor Release -

- Appearance may be observed by slicing thin sections of flan with a sharp knife and carefully examining with an illuminated hand lens.
- Mouthfeel is judged organoleptically or by instruments when they can be correlated.
- Flavor release, which is also judged organoleptically, is excellent for carrageenan flans. It must be stressed that organoleptic testing, like gel strength testing, should be done at the same temperature.

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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. For European approvals refer to EEC number E407.

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WARRANTY:
Because of the numerous factors affecting results, FMC BioPolymer ingredients are sold on the understanding that purchasers will make their own test to determine the suitability of these products for their particular purpose. The several uses suggested by FMC BioPolymer are presented only to assist our customers in exploring possible applications. All information and data presented are believed to be accurate and reliable, but are presented without the assumption of any liability by FMC BioPolymer.

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.