Ashland Specialty Ingredients
ashland.com

FTR 005

An Alternative to Guar Gum in Ice Cream Applications

With Aquacel™ GSJ-D Cellulose Gum

Overview

Cellulose gum is a widely used stabilizer in standard, premium and economical ice cream and frozen dessert formulations. Guar gum, also commonly used, has historically been a low-cost ice cream stabilizer used in concert with or as a replacement for cellulose gum. Current market conditions have put pressure on guar prices and supply. In many applications cellulose gum can replace guar with little impact on or even improvements in performance.

The advantages of cellulose gum include the following:

- Rapid hydration for quick viscosity
- High water binding
- Effectiveness at low concentrations
- Wide range of viscosity grades for desired thickness
- Variety of particle sizes to facilitate handling
- Low microbial contribution

Aquacel GSJ-D cellulose gum is specifically designed to supplement or replace guar in dairy applications. This unique cellulose gum grade will enhance mouthfeel, control melt down and reduce heat shock impact on ice cream formulations.

Background

Cellulose gums are used to control water mobility and texture to achieve the following benefits:

- Stability against heat shock
- Control of ice crystal size
- Desirable texture
- Improvement of eating quality
- Excellent overrun and stiffness parameters
- Control of melt profile

In the following work, Aquacel GSJ-D cellulose gum is evaluated versus guar gum for performance in an 8% fat ice cream formulation. It was found that Aquacel GSJ-D cellulose gum used alone or in a blend with guar gum performed similarly or was superior to guar gum used alone in stability and eating quality.

Methods

The formulation shown in Table 1 and the following process was used to evaluate guar replacement with cellulose gum in ice cream.

Ingredients	Weight %
Water	51.63
Cream (40% fat)	20.00
Sugar	12.00
Nonfat dry milk, low heat	11.00
Corn syrup solids, 36 DE	5.00
Stabilizer blend:	
Hydrocolloid	0.20
Emulsifier[(a)]	0.15
Carrageenan	0.02
Total	100%

[(a)]Myverol 18-04, distilled monoglyceride, Kerry Ingredients

Table 1: Ice cream, 8% fat, formulation used for study

Hydrocolloids used in this study were guar gum (approximately 5000 cP), and Aquacel GSJ-D cellulose gum. Guar gum and cellulose gum were evaluated alone or in a blend, as outlined in Table 2. Whether gums were used individually or as a blend, total hydrocolloid was used at 0.2% ice cream batch weight.

Ratio Guar gum:Cellulose gum	Weight % Guar gum	Weight % Cellulose gum
100:0	0.20	0.00
30:70	0.06	0.14
0:100	0.00	0.20

Table 2: Hydrocolloid portion of the stabilizer blend used for study as ratio of guar to cellulose gum and weight percent in ice cream batch

Process

Ice cream mix was formulated by dry blending the hydrocolloid(s) with a portion of the sugar then adding to the water under agitation by a Silverson homogenizer for several minutes until no lumps appeared. Mixes were stirred with an overhead mixer fitted with a large propeller-style attachment for addition of nonfat dry milk and corn syrup solids. Stirring continued for 1 hour, adjusting rpm as needed to ensure mixing and minimize air entrainment. Cream was added and mixing continued for 5 minutes.

Ice cream mix was processed on the MicroThermics HTST/UHT equipment for high temperature short time (HTST) using the following settings: preheat 30°C, final heat 78°C, 25 second hold, homogenized 2000/500 psi, cool to 10°C packout, pasteurization and homogenization. Mix was aged overnight before freezing.

Ice cream mix was frozen in an Emerson batch freezer. Vanilla flavor was added and thoroughly mixed prior to freezing. Freezing parameters of temperature, overrun and stiffness were monitored to ensure consistent freezing process among batches. Ice cream was packed out at approximately −6.0°C. Ice cream was packed into 12 ounce cardboard cups with plastic lids. Samples were hardened overnight in a cryogenic freezer at −40°C. After hardening, samples were placed in a −18°C freezer for storage.

Melt profile evaluation is performed by allowing ice cream to melt in a controlled way and capturing those melting characteristics. Ice cream was placed on a screen that was then placed over a vessel. The weight of the melting ice cream was taken at specific time intervals. The melting ice cream was also photographed.

Results

Results on overrun and stiffness measurements taken at the time of freezing as well as information comparing melt down characteristics are presented in what follows.

In Figure 1 it can be seen that ice cream made with guar had a slightly higher overrun and lower stiffness than ice cream made with a blend or with all cellulose gum. It is expected that lower stiffness is found in ice cream with higher overrun. Differences are not considered to be large.

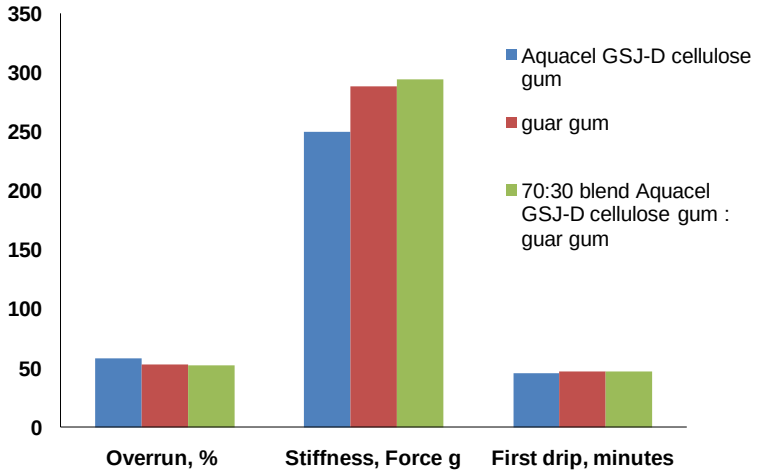

Figure 1. Overrun, stiffness and melt parameters of ice cream made with Aquacel GSJ-D cellulose gum, guar gum or blend

Ice cream made with guar gum versus cellulose gum-stabilized ice cream melted at similar rates. It can be seen in Figure 1 that time before the first drip during melting was almost the same for all ice cream samples. In Figure 2 the data for melting at ambient temperature can be seen; the ice cream stabilized with guar gum, cellulose gum or the blend all performed in similar manners. This indicates the hydrocolloids provide structure to the ice cream aqueous phase in a similar way, thus providing protection from rapid melt down.

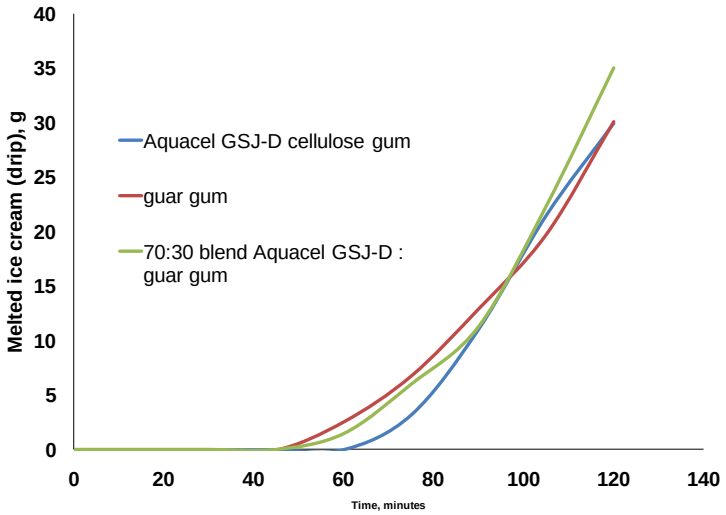

Figure 2. Melt profile of ice cream stabilized with Aquacel GSJ-D cellulose gum, guar gum or blend

The photographs in Figure 3 show the ice cream during the melt test. These photos indicate that the ice cream structure was maintained in a similar way in ice cream made with guar gum, cellulose gum or the blend.

Melt Profile—Cellulose gum
Ice cream stabilized with 0.2% cellulose gum

0 minutes 60 minutes 120 minutes

Melt Profile—Guar gum
Ice cream stabilized with 0.2% guar gum

0 minutes 60 minutes 120 minutes

Melt Profile—Cellulose gum + guar gum
Ice cream stabilized with 0.06% guar gum and 0.14% cellulose gum

0 minutes 60 minutes 120 minutes

Figure 3. Photographs showing melt profiles over 2 hours at ambient temperatures

Sensory evaluation with Dr. Bruce Tharp

Stabilizers in ice cream control ice crystal formation therefore ice cream was evaluated primarily for texture differences (smoothness, iciness, crunch, etc). Stabilizers also can impact ice cream body detected by the way ice cream breaks apart in the mouth, and may be described as full body, chewiness, or crumbliness. A panel of eight participants knowledgeable in ice cream was assembled and ice cream texture evaluation was conducted under the guidance of Bruce Tharp, PhD, a well-known expert in ice cream, ice cream processing and stabilizers from Tharp's Food Technology, Wayne PA. All ice cream samples were evaluated blind.

Tasting results—Ice cream samples in normal storage

Ice cream samples were very similar, with good textures. On a scale of 1 (worst) to 5 (best) the three samples rated around 4 (see Figure 4). Differences in texture were not detected between ice creams made with guar gum, cellulose gum or the blend. Ice cream made with cellulose gum had a bit more desirable body, detected by most participants.

Tasting results—Heat shocked ice cream samples

Ice cream samples underwent three cycles of warming and refreezing prior to evaluation. Again using the rating system scale of 1 (worst) to 5 (best) the three samples rated around 4 minus for texture and body.

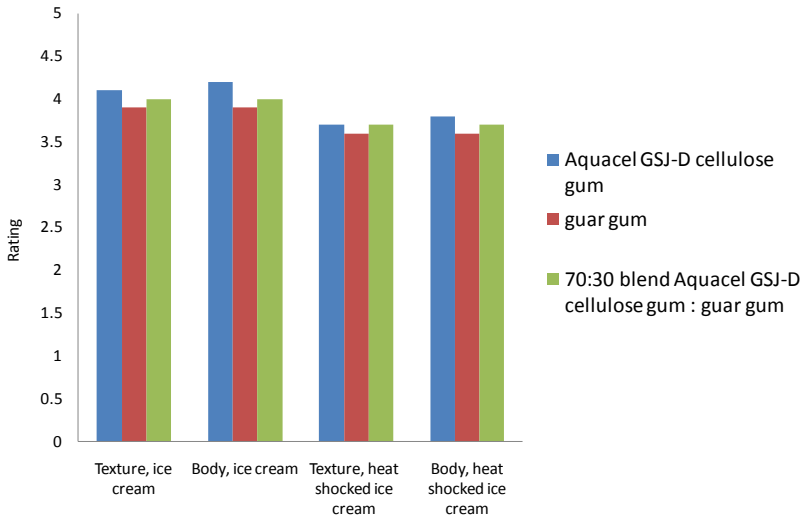

Figure 4. Ice cream made with Aquacel GSJ-D cellulose gum, guar gum and blend—Texture and body evaluation

Conclusions

In this study, ice creams stabilized with guar gum, Aquacel GSJ-D cellulose gum or a blend of the two were evaluated for their stability characteristics and mouthfeel. It was found that the ice creams performed similarly in overrun, stiffness and melt down properties. Sensory evaluation with an expert in the area also supported that there were no large differences between stabilizers in impact on texture or mouthfeel for ice cream stored under normal conditions or even in ice cream that had undergone temperature abuse (heat shock).