SPI Polyols™

TECHNICAL BULLETIN

How SORBO® Sorbitol Solution Maintains Quality & Freshness of Grained Confections

Introduction

Few industries have had to face the challenges that confront the candy industry today. Candies are often stored longer, under a wider variety of conditions, and are shipped further today than was typical several years ago. Yet, the candy pieces that must withstand these modern marketing conditions were originally intended for consumption a short time after they were made. How, then, can candies retain their traditional quality and flavor and still meet the demands of modern marketing? One way is to use a small amount of SORBO® Sorbitol Solution.

Keeping Candy Fresh

Solving the problem of maintaining as-made quality and freshness depends on two things: (1), the development of the desired grain, as made, and (2) maintaining the optimum balance between the syrup and crystal phases of the candy piece.

When confections "stale", they lose the critical balance between the syrup and crystal phases, develop coarse sucrose crystals, and, consequently, "dry out". The staling process may be alleviated by one or more of these means: (1), packaging that provides greater environmental protection; (2), frozen storage, refrigerated trucks and display cases; or (3), the use of high-quality ingredients, including SORBO® Sorbitol Solution.

Many candy producers have found that they can maintain the as-made quality and freshness of their candies for as much as three times longer by including as little as 0.5% SORBO® Sorbitol Solution in their formulations. The amount of SORBO® Sorbitol Solution required to produce extended shelf life varies, depending on the amounts and types of corn syrup and other doctors in the formulation.

How SORBO® Sorbitol Solution Works

Maximum shelf life (for both grained and non-grained confections) depends primarily on two factors: (1), the size of the sucrose crystals of the candy piece, and (2), the balance between the syrup phase and the crystal phase of the candy piece. SORBO® Sorbitol Solution, when used correctly, promotes the formulation of fine sucrose crystals, retards their rate of growth, and helps establish the proper balance between the syrup and crystal phases.

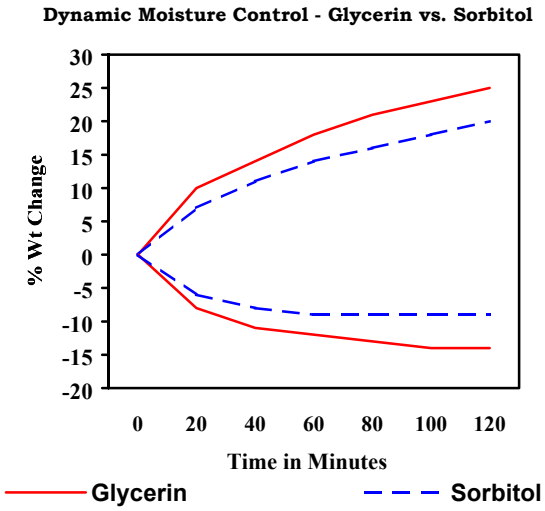
Achieving the proper balance between the crystal and syrup phases without the use of SORBO® Sorbitol Solution requires precise control over production conditions. While it may be possible to achieve the high degree of control required, maintaining it is impractical under the typical conditions involved in candy making. However, proper balance can be achieved and maintained when the proper amount of SORBO® Sorbitol Solution is in the candy formula. SORBO® Sorbitol Solution provides a practical and inexpensive means to achieve the extended shelf life required in the market today.

Balance

The balance between the crystal phase and the syrup phase of a candy piece can significantly increase – or decrease – its shelf life. If the crystal and syrup phases are not in proper balance, sucrose crystals may grow excessively and the candy piece may become extremely dry before it reaches the end of its normal shelf life.

Note the Dynamic Moisture Control Graph below. The curves show the rate of moisture gain when solutions of sorbitol or glycerin in hygroscopic equilibrium at 58% relative humidity (RH) are transferred to an atmosphere of 79% RH; also the rate of moisture loss when such solutions are placed in a 32% RH atmosphere. Note that the sorbitol solutions neither gain nor lose water as rapidly as the glycerin solutions. More stability, better balance, better shelf life.

In some confections, establishing proper balance between the syrup and crystal phase is often all that is necessary to make a finer candy piece that has extended shelf life.



Crystallization

In the production of any confection, there is a point at which sucrose crystallization should take place to ensure maximum shelf life. If crystallization takes place on either side of an "optimal point", the crystals will be either too large or too small to achieve the stability required for maximum shelf life.

Where this point would be located depends on the formulation of the candy piece and its production process. The optimum point of crystallization depends on the amount and type of grain control agents in the confection, the type of corn syrup in the formula, the solids content of the batch, and whether or not seed is used, as well as the degree of heating and super-cooling.

In a commercial candy formula there are many ingredients, each of which will have some effect on sucrose crystallization. Dextrins, corn syrup, and gums are often added to control crystallization, but proper syrup and crystal phase balance must still be maintained.

Controlling the Variables

The candy maker seeks to crystallize each of the many confections he produces at the point of "optimum crystallization." To accomplish this requires exacting control of his production process. To maintain this precise control of each of the many variables affecting his production is extremely difficult.

Laboratory studies have shown that the inclusion of SORBO® Sorbitol Solution in the doctor system of a confection will "complex" the total sucrose/doctor system, providing the confectioner a broader area in which he can crystallize his confection and still be at the optimum point as measured by quality and shelf life.

How to Use SORBO® Sorbitol Solution

The best way to establish the amount of SORBO® Sorbitol Solution necessary to give any confection maximum shelf life, is to vary the amounts of SORBO® Sorbitol Solution in the basic candy formula in quantities ranging from 0.5% to 3.0% either by weight or volume as a replacement for the equivalent amount of corn syrup solids.

It should also be understood that the amount of SORBO® Sorbitol Solution needed to produce maximum shelf life will vary between 0.5% and 3.0% depending on the type of corn syrup in the formula. For example, a confection containing 42 DE acid converted corn syrup may need 3.0% SORBO® Sorbitol Solution, whereas the same confection containing 42 DE high maltose corn syrup may need only 0.7% SORBO® Sorbitol Solution.

How, then, does a candy maker calculate how much corn syrup to remove when adding a specific percentage of sorbitol to his candy formula? One method is to remove one pound of corn syrup solids from the formulation for every pound of sorbitol solids added. Below, is an example of the type of calculation recommended to figure how much SORBO® Sorbitol Solution should be used:

Typical calculation of the addition of 1% SORBO® Sorbitol Solution to a thousand-pound batch of cream mints:

1. Addition of sorbitol solids: 10 pounds SORBO® Sorbitol Solution = 1% SORBO® Sorbitol Solution on total weight 70% sorbitol solids added to batch 7 pounds sorbitol solids added to batch

2. Removal of corn syrup solids:

$$\left(\frac{\text{7 pounds of solids to be removed}}{\text{80\% solids content (42 DE) corn syrup}}\right) = \frac{X}{100}$$

Therefore,

X = 8.7 pounds of corn syrup solids to be removed.

80X = 700

3. Check:

(8.7 pounds of corn syrup solids) x (80% solids) = 7.0 pounds of corn syrup solids

Another simpler method is to remove a pound of corn syrup for every pound of SORBO® Sorbitol Solution added. Equivalent results are obtained from both methods of addition at the low levels of sorbitol recommended.

Measuring Performance

The effect SORBO® Sorbitol Solution has on grained and non-grained confections may be measured by several different means. An Instron Universal Tester Model 1122 was used to measure the firmness of such pieces as fudge, marshmallow, nougat, etc. A microscope, with camera attachment took photomicrographs of grained confections to record as-made grain and subsequent crystal growth. Analytical taste panel evaluations provided data on softness, graininess and overall acceptability of the candy pieces.

Altogether, these tests showed that confections containing the right amount of SORBO® Sorbitol Solution had as much as three times longer shelf life than their counterparts which contained no SORBO® Sorbitol Solution at all.

SPECIFIC LABORATORY STUDIES

I. Starch Cast Cream Mints (Enrobed):

(Formulation and Procedure, See Appendix A.)

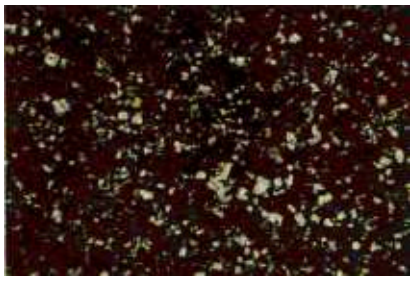


Figure 1. Control Mint
(42 DE Corn Syrup, 0% SORBO®)

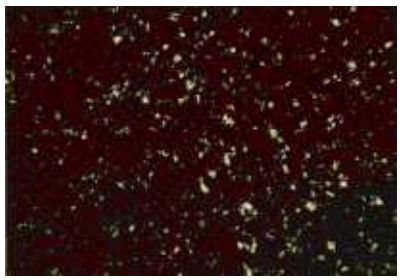


Figure 2.
(42DE Corn Syrup + 3% SORBO®)

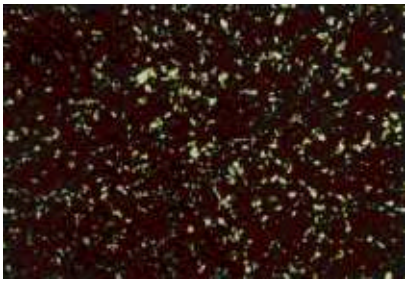


Figure 3. Cream Mint containing
(42 DE High Maltose Syrup + 0% SORBO®)

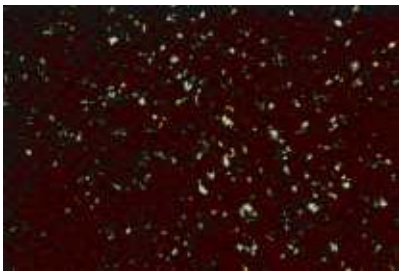


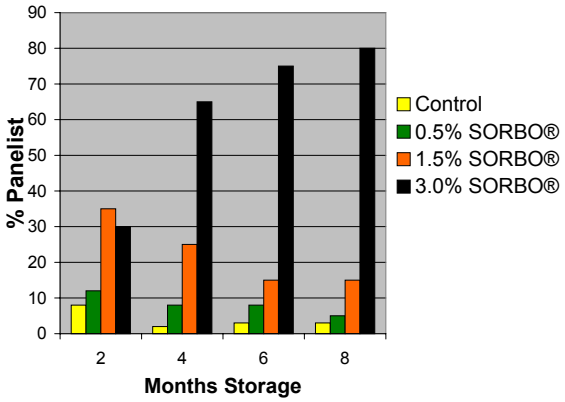
Figure 4. Cream Mint containing
(42 DE High Maltose Syrup + 0.5% SORBO®)

In the laboratory, SORBO® Sorbitol Solution was used in various ratios with corn syrup, as a replacement for corn syrup on a solids basis.

The benefits derived from using SORBO® Sorbitol Solution properly are shown in Figures 1 and 2; photomicrographs (150X, polarized light, 1/5 sec.) of sucrose crystals from two batches of cream mints. Figure 1 is a photo of the control mint. It was prepared with 42 DE corn syrup and contains no sorbitol solution. Figure 2 is a cream mint containing 3.0% SORBO® Sorbitol Solution. Both batches were prepared with identical corn syrups and have the same amount of invert sugar.

There is a significant difference in the size of the sucrose crystals in each of the mints. The mint containing 3.0% SORBO® Sorbitol Solution has finer grain. Taste panel tests carried out over a period of eight months also demonstrated the ability of SORBO® Sorbitol Solution to extend shelf life. (Figure 5).

Figure 5. Cream Mints (Temperature at 72° F)
% Distribution Least Grainy to Most Preferred



In some instances it is not possible to detect a difference in grain owing to the fact that crystallization may have been optimal initially. Even so, data are available to show that it is possible to extend the shelf life of a confection by adding a small quantity of SORBO® Sorbitol Solution to the batch.

Figure 3 is a photograph of another cream center prepared with 42 DE high maltose corn syrup. It contains no SORBO® Sorbitol Solution. Figure 4 is a photo of the same type of cream, except that it contains 0.5% SORBO® Sorbitol Solution. There is no significant difference in grain, but shelf life studies showed the batch of centers containing 0.5% SORBO® Sorbitol Solution were preferred after six months' storage.

Better texture was the reason the taste panel cited for its preference for the mint containing 0.5% SORBO® Sorbitol Solution over the control mint (Figure 5). Laboratory examination of the preferred mint showed that its selection could be explained by the better conditioning of the syrup phase.

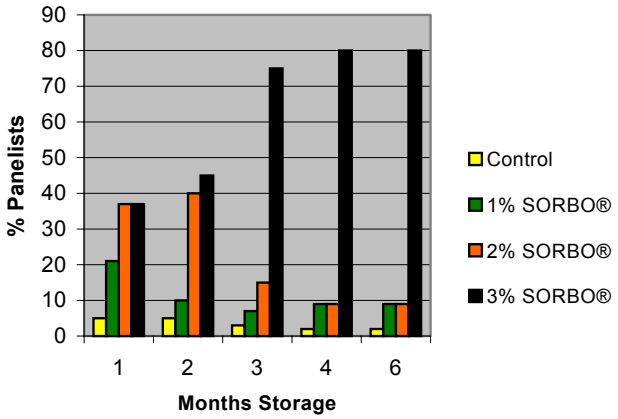
While there was no difference in grain between the two batches of mints, the better condition of the syrup phase of the mint containing 0.5% SORBO® Sorbitol Solution improved moisture retention. In this particular formulation, with this particular corn syrup, a higher level of SORBO® Sorbitol Solution would have upset the balance between the crystal and syrup phases of the batch and shelf life would be similar to that of the control.

II. Grained Marshmallow – Starch Cast

(Formulation and Procedure shown in Appendix A.)

To test the effect of SORBO® Sorbitol Solution on cast, grained marshmallow, four batches of marshmallow were produced according to accepted

Figure 6a. Taste Panel Evaluation Grained Marshmallow
at Room Temperature - Rating for Least Grainy



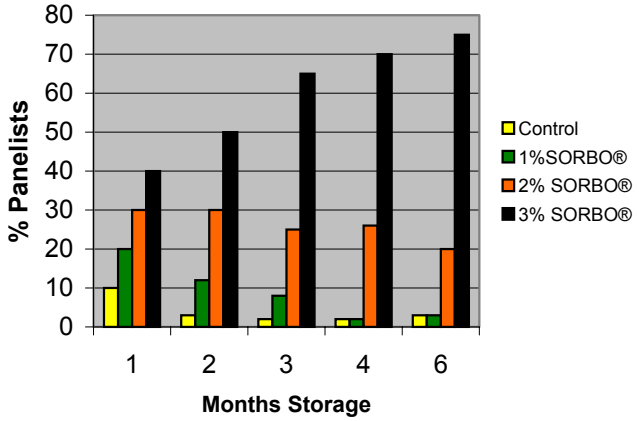
commercial techniques. Of these batches, one contained no SORBO® Sorbitol Solution, and the rest contained 1.0%, 2.0%, and 3.0% SORBO® Sorbitol Solution, respectively (procedure and formulation detailed in Appendix A). The marshmallows were stored at room temperature and evaluated at monthly intervals by an analytical taste panel, chosen for their ability to differentiate between minor taste sensations.

The marshmallows were allowed to stand in starch at room temperature (78°F) for 1.5 hours, then held for 24 hours at 110° F. After 24 hours, they were removed, boxed and wrapped with confectioner's cellophane and stored at room temperature.

During the six months' study, the piece containing 2% SORBO® Sorbitol Solution rated second choice consistently. However, during the first three months, some of the panelists preferred the pieces containing only 1% SORBO® Sorbitol Solution. After the third month, more of the panel members preferred the marshmallow containing 3% SORBO® Sorbitol Solution. In every laboratory test, the marshmallow containing 3% SORBO® Sorbitol Solution was rated most preferred and least grainy. As the months passed, the preference for this marshmallow became more and more pronounced, as shown in.

Only during the first month did any of the panelists indicate a preference for the control containing no SORBO® Sorbitol Solution, and then only ten percent of the panelists. At no time did any of the panelists rate the Control as being least grainy. The fact that some of the panel members indicated a preference for the low level of SORBO® Sorbitol Solution during

Figure 6b. Taste Panel Evaluation- Grained Marshmallow at Room Temperature, Rating for Most Preferred



the early months of the test is consistent with past experience in tests of various types of grained confections containing SORBO® Sorbitol Solution.

It has been found with most taste panel evaluations involving foods which become progressively firm during aging, that there is always a minority of panelists who prefer a certain degree of firmness not consistent with the preference of the majority. However, these people do not want more than a certain degree of firmness, as is evident in this marshmallow study by the decreasing preference for the firmer pieces and the total lack of preference for the control and low level of SORBO® Sorbitol Solution after the third month.

III. Bar Fudge: Slab, suitable for cutting:

(Formulation and Procedure shown in Appendix B.)

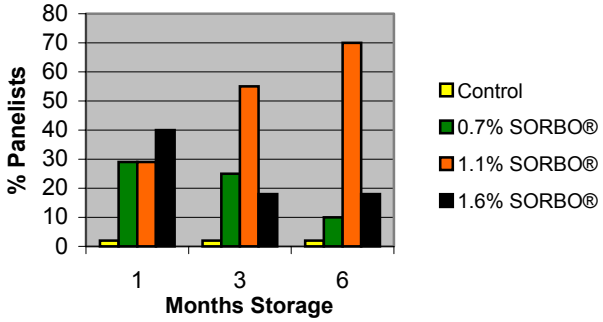
The control fudge contained no SORBO® Sorbitol Solution. The other batches contained, respectively, 0.7%, 1.1%, and 1.6% SORBO® Sorbitol Solution based on total weight (in the evaluation of this particular fudge SORBO® Sorbitol Solution was added to the batch as a part of the bob syrup - as a replacement for corn syrup on a weight/weight basis, not on a solids basis). After the fudge was made, using commercial manufacturing practices, the candy was stored at room temperature for six months. Evaluations were made at monthly intervals.

The taste panel (Figure 7) selected the bar fudge containing 1.1% SORBO® Sorbitol Solution as not only the softest but also possessing the finest grain, during the six months' storage period. This fudge was preferred over that containing 1.6% SORBO® Sorbitol Solution. None of the panelists selected the control fudge, which contained no SORBO® Sorbitol Solution, because of its coarse grain and rapid rate of firming.

Penetrometer readings were taken at the same intervals as the taste panel evaluations. In every case, the firmness of the various batches of fudge, as m SORBO® measured by the Penetrometer, correlated directly with the taste panel results.

At one-month intervals, softness determinations were made using the Penetrometer. Figure 8, a plot of the softness values obtained over the test period, shows the fudge containing 1.6% SORBO® Sorbitol Solution to be equivalent in firmness to the control fudge containing no SORBO® Sorbitol Solution. As previously mentioned it has been found that high levels of SORBO® Sorbitol Solution in many

Figure 7. Fudge: Room Temperature
% Distribution
Least Grainy and Most Preferred



instances excessively dilute the syrup phase and permit uncontrolled, relatively spontaneous crystallization to take place. In more than one instance it has been shown that for ideal crystallization to take place with the development of an optimum crystal structure it is essential that the solids/syrup phase be in the proper equilibrium. In day-to-day plant practice reliance is placed on the experience of the candy maker to obtain this desirable balance.

Figure 8 also shows that the batch of fudge containing 0.7% SORBO® Sorbitol Solution is the softest. Normally, one might consider this to be the most desirable fudge, but the grain of this fudge was somewhat coarse and was noted by the taste panel (Figure 7).

Thus, the taste panel and Penetrometer data show that bar fudge containing 1.1% SORBO® Sorbitol Solution was the least grainy and the most desirable throughout the six months of the test period. It should

also be noted that this type of fudge had sufficient structural strength to withstand mechanical cutting.

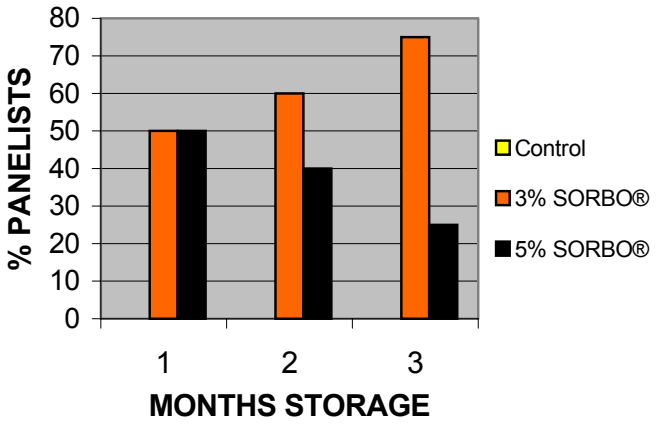
IV. High Cook Caramel, Starch Cast:

(Formulation and Procedure shown in Appendix B.)

To test the effect of SORBO® Sorbitol Solution on high cook caramel, studies were conducted to determine if it would be possible to 1.) produce a more tender caramel, initially, and 2.) extend the shelf life of the finished piece. At intervals of one month, the coated caramels were submitted to a taste panel to determine which was the softest and most preferred.

As shown in Figure 8, the control caramel containing 0% SORBO® Sorbitol Solution was never selected as the softest.

Figure 8. High Cook Caramel
Room Temperature (72° F) - Softest and Most Preferred



At 2 months, the caramel containing 3.0% SORBO® Sorbitol Solution was rated as the softest and most preferred, and the difference between 3.0% and 5.0% widened with additional storage time. At 2 months and beyond, the caramel containing 5.0% SORBO® Sorbitol Solution was rated as being tougher than the batch containing 3.0% SORBO® Sorbitol Solution but not as tough as the control.

APPENDIX A:

Starch Cast Cream Mints (Enrobed)

Formula (Basic)

I. (Bob Syrup[1])

Sucrose	20.0	20.0	20.0	20.0
Corn Syrup 42DE	12.0	11.6	10.7	9.4
H_2O	3.9	3.8	3.7	3.5
SORBO® [2]	----	0.5	1.5	3.0

note: all values are expressed in percentage of dry solids

II. (Remelt)

Fondant (80/20 242°F Cook)	20.0	20.0	20.0	20.0
Mazetta [3]	16.0	16.0	16.0	16.0
Invertase	0.1	0.1	0.1	0.1
Flavor	0.1	0.1	0.1	0.1

note: all values are expressed in percentage of dry solids

Procedure:

1. Cook I. to 246°F. Cover kettle to wash down sides and insure solution of all sugar crystals.
2. Cool bob syrup (I) down to 150°F, add fondant and mazetta and mix well.
3. When bob syrup, fondant and mazetta are well mixed, and temperature has been adjusted to 150°F, add flavor and invertase.
4. Pipe into starch molds, let stand 3 hours; dust and enrobe.

[1] Bob syrup is a term for a non-crystallizing mixture of sugars added to fondant.

[2] Addition of SORBO® 70% Sorbitol Solution
Extensive testing has shown that SORBO® Sorbitol Solution is used to best advantage when added to and cooked with the bob syrup.

[3] Mazetta is a whipped product containing egg albumen or gelatin, used for aeration (also known as egg frappe).

Grained Marshmallow - starch cast

Formulas

	Control	1%	2%	3%
Sucrose	42.5	42.5	42.5	42.5
Corn Syrup 42DE	28.4	27.2	26.3	25.4
Gelatin 225 Bloom	9/4.3	9/4.3	0/4.3	0/4.3
Fondant 80/20	11.0	11.0	11.0	11.0
SORBO® [4]	----	1.2	2.1	3.0
H_2O	12.9	12.9	12.9	12.9
total	100.0	100.0	100.0	100.0
Color	q.s.	q.s.	q.s.	q.s.
Flavor	q.s.	q.s.	q.s.	q.s.

note: all values are expressed in percentage of dry solids

Procedure:

1. The water, sucrose, corn syrup, and SORBO® Sorbitol Solution (when used) were heated to 180°F (just sufficient heat to dissolve ingredients). The heated solution was examined by refractometer for dissolved solids content and all batches cooked to 79% solids.
2. The solution was then transferred to a Hobart mixer and agitated at low speed.
3. The mixed batch was cooled to 155°F and the fondant thoroughly incorporated.
4. The solution was then agitated at high speed and the gelatin/water "solution" was slowly added during agitation.The total batch was whipped to density of four pounds per gallon. Flavor and color were finally added, and the marshmallow was cast into starch at a temperature of 115°F to 120°F.

[4] Based on total weight: in the evaluation of the marshmallow SORBO® Sorbitol Solution was added to the batch as a replacement for corn syrup on a weight/weight basis, not a solids basis.

APPENDIX B:

Bar Fudge: Slab, suitable for cutting

	#1	#2	#3	#4
Corn Syrup 42DE	28.4	27.2	26.3	25.4
Sweetened Condensed Milk	16.6	16.6	16.6	16.6
Sucrose	23.7	23.7	23.7	23.7
Hard Fat (92°F M.P.)	3.8	3.8	3.8	3.8
H_2O	3.7	3.7	3.7	3.7
Salt	0.1	0.1	0.1	0.1
Fondant (80/20)	23.7	23.7	23.7	23.7
SORBO®	----	0.7	1.1	1.6
total	100.0	100.0	100.0	100.0

Procedure:

1. The corn syrup, water, sweetened condensed milk and SORBO® Sorbitol Solution (when used) were warmed on a steam bath and then placed in a steam-jacketed kettle.

2. The dry ingredients were slowly added with agitation and the batch was brought to 246°F.

3. The heat was removed and the fat added. The fondant was added at 203°F and thoroughly incorporated, avoiding excessive agitation.

4. The batches were cast into wooden trays lined with silicone paper and allowed to stand for 24 hours.

5. They were then cut, packaged in confectioner's cellophane and stored for shelf life study

High Cook Caramel, Starch Cast

I. Caramel

	Control	3% SORBO®	5% SORBO®
Sucrose	19.3	19.3	19.3
Corn Syrup 63DE	39.9	36.9	34.9
Sweetened Condensed Milk	29.6	29.6	29.6
Butter	3.5	3.5	3.5
Salt	0.7	0.7	0.7
Caramel Paste	3.3	3.3	3.3
Lecithin	0.1	0.1	0.1
Invert Sugar	3.6	3.6	3.6
SORBO® [5]	----	3.0	5.0
total	100.0	100.0	100.0

II. Caramel Paste

Corn Syrup 63DE	36.9
Sucrose	24.7
Sweetened Condensed Milk	11.8
Starch 60 Fluidity [6]	9.0
Vegetable Oil (76°F M.P.)	6.0
Butter	1.3
Vanilla	0.1
H_2O	18.3
total	100.0

Procedure:

I. Caramel

1. All ingredients were weighed into a kettle and heat gradually applied to warm batch slowly to 150°F. Again care was taken to prevent sticking or scorching.

[5] **SORBO®** Sorbitol Solution added to caramel as a replacement for corn syrup on a weight/weight basis.
[6] Confectioners thin-boiling starch

2. When the batch was homogeneous, and at 150°F, temperature was then increased to 255°F.

3. The batch was cooled to 245°F and maintained at this temperature while being cast into starch (90°F).

4. After 24 hours, the caramels were removed from starch, dusted and enrobed with dark sweet chocolate. The samples were then boxed, wrapped in confectioner's cellophane and put away for shelf life tests.

II. Caramel Paste

1. All ingredients were weighed into a stainless steel bowl and heated with steam to 150°F, using agitation to keep the starch and condensed milk from sticking and burning.

2. The paste was held at 150°F. **It is important to maintain a homogeneous paste mixture through out this heating step.**

3. Heat was again applied and the paste cooked to 220°F, cooled, and held for the caramel.

SPI Polyols™

Sorbitol and Non-Crystallizing Sorbitol Solutions

Sorbitol Solutions are made up of at least 64% Sorbitol and water, while Non-crystallizing Sorbitol Solutions consist of 45 to 55% Sorbitol, 10 to 20% hydrogenated polysaccharides and water. It's in adding these higher polysaccharides that give the latter their non-crystallizing properties.

Sorbitol Solutions	Non-Crystallizing Polyol Solutions	Functions
SORBO® **SORBO® I** **70% Sorbitol Solution – USP** **70% Sorbitol Solution – MC (low microbial)**	**A-625**	Acts as a humectant, bulking agent, crystallization inhibitor, gloss enhancer, non-cariogenic sugarless sweetener, plasticizer, calorie reducer, and moisture control agent in applications such as: **Confectionery** • **Chewing gum** • **Cream Centers** • **Fondants** • **Hard Candy** • **Grained Confections**
SORBO® MP **70% Sorbitol Solution – HM**	**ARLEX® 2000**	
SORBO® 1179 **70% Sorbitol Solution – LM**		
SORBO® Heat Stable 70 **SORBO® Heat Stable 80** **70% Sorbitol Solution – HSC** **70% Sorbitol Solution – HMTS**	**SORBOBRITE™**	

note: each sorbitol and non-crystallizing sorbitol solutions are grouped with their relative equivalent.

SPI Polyols™

How Can We Help You?

Ask what's new in our line of products!

MANNOGEM™ Mannitol Powders
SORBO® Sorbitol Solutions
SORBOGEM™ Crystalline Sorbitol Line
AMALTY® Crystalline Maltitol
MALTISWEET™ Maltitol Solutions
SUNMALT-S™ Crystalline Maltose
STABILITE™ Hydrogenated Starch Hydrolysates
HYSTAR® Hydrogenated Starch Hydrolysates

Polyols are hydrogenated sugars, but they are not processed by the body like sugars. They have many advantages—they have a reduced caloric value compared to sucrose; reduced insulin response; recognition as non-"sugars" – can be labeled "sugar-free" and "no sugar added"; noncariogenic properties (they do not promote tooth decay); and they do not brown in bakery applications (i.e. no Maillard reaction).

Some characteristics of polyols are fewer calories, pleasant sweetness, ability to hold moisture, and improved processing. Polyols serve as humectants, bulking agents, and freeze point depressants. Maltitol is an excellent direct replacement for sucrose in baked goods and confectioneries, and is 2.1 kcalories/gram compared to 4.0 kcalories for sucrose. Sorbitol is an excellent humectant, retaining moisture much better than glycerin, and it may be used with gum arabic for a much-improved coating shelf life. SPI's unique maltitol syrups and hydrogenated starch hydrolysates serve as excellent binders utilizable in a wide range of carbohydrate and protein levels. Polyols are versatile ingredients, used in a variety of applications to provide value-adding properties.

SPI Polyols has a range of products with different properties and applications.

Visit us online at **www.spipolyols.com**

SPI Polyols™

321 Cherry Lane, New Castle, Delaware 19720-2780
1-800-789-9755, EXT. 8534
FAX: 302-576-8569