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Understanding Polyols for use in Reduced Sugar, No Sugar Added, And Sugar Free Bakery Applications

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With an increasing part of the U.S. population becoming overweight and/or diabetic, consumers are looking for ways to make weight loss and healthy living easier. Traditional sweet baked products — such as cookies, cakes, or muffins — can be reformulated as no sugar added, reduced sugar, and sugar free, providing the consumer with useful tools to lessen the pains of dieting. Unfortunately for the product developer, just supplying any functional product will not do. These no sugar added, reduced sugar, and sugar free products need to look like, taste like, and have the same quality of their sugar counterparts in order to satisfy the consumer. If they do not, it doesn't matter how nutritionally beneficial they are, the mainstream consumer will not buy them. Although creating a similar product is often the biggest hurdle, it's not the only one. The developer must also design a product that can be manufactured with relative ease — in most cases using existing processing equipment — as well as one that is cost effective to produce.

So the question is — what does a product developer use to create these no sugar added, reduced sugar, and sugar free baked products? The most obvious answer is to use something that offers the same bulk and functionality as sugar. This might seem like a difficult task, but it's not. There is a unique group of low-digestible carbohydrates — not considered sugars (21 Code of Federal Regulations [CFR] 101.9) — called polyols or "sugar alcohols." They are ideal sugar replacements, providing bulk and adding functionality to just such applications. One of the main benefits of these polyols is that they are metabolized more slowly by the body than traditional sugars (i.e., glucose, maltose, and sucrose) and carbohydrates (i.e., corn syrups, maltodextrin, and starches), in turn lowering the blood glucose response and caloric density (Table I) when eaten. Caloric values reported in Table I represent accepted values by the respective regulatory bodies from the United States (Food and Drug Administration) and European Union (Food Standards Agency).

Polyols are not new to the food industry and have been used by diabetics for decades to help manage their blood glucose levels. However, until recently their applications were primarily limited to sugar free confections, such as hard candy, chocolate, and chewing gum. This limitation was due to the fact that 10 to 15 years ago there was a very narrow range of economically priced polyols to choose from. But with the recent advances in biotechnology and processing, this has all changed. Now there are more options available for the product developer to create high-quality, great-tasting, no sugar added, reduced sugar, and sugar free baked goods.

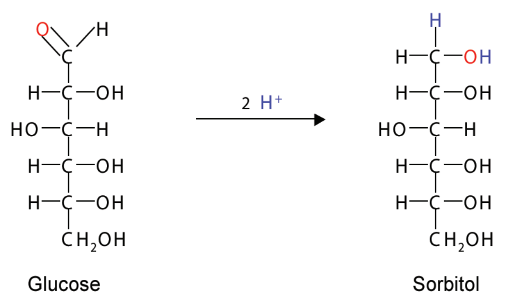
Table 1. Calories

	U.S.	E.U.
Erythritol	0.2	0.2
Mannitol	1.6	2.4
Isomalt	2.0	2.4
Lactitol	2.0	2.4
Maltitol	2.1	2.4
Xylitol	2.4	2.4
Sorbitol	2.6	2.4
Maltitol syrup	3.0	2.4
Polyglycitol syrup	3.0	N/A
Sucrose	4.0	4.0

Polyols: Carbohydrate Derivative

Why are polyols such effective bulk sugar replacers? The answer to this question becomes more apparent when examining their origin. In the United States, polyols start out as traditional corn syrups that are then modified by reducing reactive sites (aldehyde or ketone) through either one or a combination of the following production methods: catalytic hydrogenation, enzymatic conversion, or fermentation (Figure 1). Because only the reactive groups are changed, polyols retain much of the sugar's structure, bulk, and function, which makes them the ideal 1:1 bulk replacement for sugar. In addition, all of the polyols are considered either a "Food Additive" or "Generally Recognized As Safe" (GRAS) by the Food and Drug Administration (FDA), as noted in Table II.

Figure 1. Calories— Glucose to Sorbitol

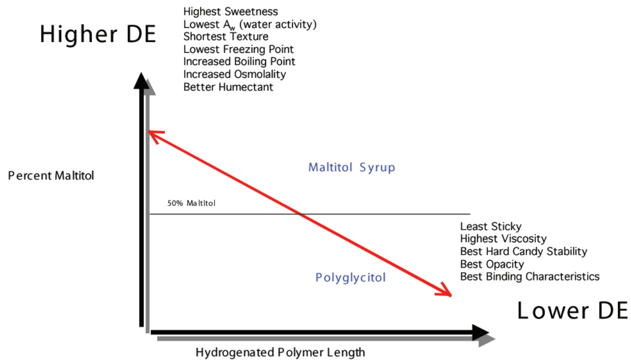


Polyols can be divided into three groups: monomers, dimers, and polymeric mixtures. The monomers — consisting of one carbohydrate unit — are erythritol, mannitol, sorbitol, and xylitol. The dimers — consisting of two bonded carbohydrate units — are isomalt, lactitol, and maltitol. And the polymeric mixtures are combinations of polyols — varying in lengths of repeating carbohydrate units — that are identified as polyglycitol syrups, also known as hydrogenated starch hydrolysates (HSHs), and maltitol syrups (these are the most similar to corn syrups). Nomenclature is determined by the amount of maltitol (dry basis) present; a syrup that contains greater than 50% maltitol is considered a maltitol syrup, and anything less is a polyglycitol syrup (Figure 2).

Table II. Regulatory Status

	U.S. Status	E.U. Approval
Sorbitol	GRAS (21 CFR184.1835)	Yes
Mannitol	Food Additive (21 CFR180.25)	Yes
Xylitol	Food Additive (21 CFR172.395)	Yes
Erythritol	GRAS1	Pending
Isomalt	GRAS1	Yes
Lactitol	GRAS1	Yes
Maltitol	GRAS1	Yes
Maltitol syrup	GRAS1	Yes
Polyglycitol syrup	GRAS1	Pending
1Self-Affirmed	GRAS	

Figure 2 — Maltitol/Polyglycitol Syrups



Physical Characteristics

A common misconception is that all polyols are the same, which is far from true. Functional and physical properties (which will be addressed next) such as sweetness, solubility, cooling effect, molecular weight, laxation, and osmotic effects can differ greatly among them. Therefore, it is important that the formulator understand these differences in order to choose the correct polyol for a successful product. Remember — no matter what nutritional benefit you provide the consumer, if the finished product doesn't taste good or causes discomfort, it will fail.

Sweetness

When talking about sweet baked goods, the first thing that comes to mind is, well, sweetness. But formulators must realize that polyols have varying levels of sweetness ranging from 0.3 to 1.0 times that of sucrose (Table III). Interestingly enough, this is the easiest attribute to work around when formulating because there are many effective high-potency sweeteners (HPSs) — such as acesulfame-potassium and sucralose — available to pick up the sweetening slack. Some formulators, however, are not interested in using these HPSs. In this case, they need to consider a polyol that can deliver the most sweetness, similar to that of sucrose, and there are a few that come close. A word of caution to the formulator: Just because a polyol might deliver the same sweetness as sucrose doesn't mean it will function well in the application. It turns out that there are many other important physical characteristics that must be considered to determine the right polyols for the application.

Table III. Sweetness

	Relative Sweetness to Sucrose (%)
Sucrose	100
Xylitol	100
Maltitol	90
Erythritol	60
Sorbitol	60
Mannitol	50
Isomalt	40
Lactitol	30-40
Maltitol Syrup	70-80
Polyglycitol	30-50

Note: Since sweetness is determined through subjective methods, these values are meant to be approximate and may vary between individuals.

Cooling Effects.

Many people who have had some experience with polyols will often refer to an associated cooling effect when using them. However, this effect is not unique to just polyols; any soluble solid ingredient will have some sort of cooling effect — or even a warming effect in some cases — while dissolving. To experience this effect, simply place a small amount of powdered sugar on the tongue. A pleasant cooling effect will be produced as it dissolves. This unique effect is known as the "heat of solution" and is an actual exchange in energy. It can either lower or raise the temperature of a solution when a substance (sugar) is added to water (or saliva). The heat of solution is measured in either joules or calories per gram and can occur if the substance interacting with water is in liquid or, in most cases, solid form. As the heat of solution decreases into negative values, the cooling effect becomes greater, and the opposite holds true for the warming effect.

Most polyols in crystalline form tend to have a cooling effect, with some being significantly greater than sucrose (Table IV). High-cooling polyols such as erythritol, xylitol, and sorbitol are perfect for formulators who want to deliver a strong cooling sensation for a specialty or mint-based application. On the other hand, a formulator might require a minimal cooling effect for an application, such as a cookie or shortened cake. In this case, he or she can choose polyols lower in cooling effect, such as isomalt, lactitol, and maltitol. If the formulator feels that the high-cooling polyol provides a certain functional advantage — such as cost, crystallization, solubility, reduced calories, or higher laxation threshold — to maintain product goals and quality, he or she can combine them with the lower-cooling polyols to reduce the overall effect. Furthermore, these high-cooling polyols can be combined very well with other low-digestible carbohydrates such as fructo-oligosaccharides, inulin, and polydextrose to create the same effect and reduce overall cooling effects. These options allow for great flexibility in sugar-free baked applications, but only if all aspects are understood well by the formulator.

Table IV. Cooling Effects

	Heat of Solution cal/g)
Glycerin	+9.0
Sucrose	-4.0
Maltitol	-5.5
Isomalt	-9.4
Lactitol	-13.9
Sorbitol	-26.5
Mannitol	-28.9
Xylitol	-36.6
Erythritol	-42.9
Maltitol Syrup	N/A
Polyglycitol	N/A

Molecular Weight.

Traditional sugars/carbohydrates like glucose, maltose, sucrose, and corn syrups all have weight. The smaller molecules of the mentioned monosaccharides and disaccharides can actually be measured, and weights are given in units of grams per mole. However, the larger molecules present in corn syrup — consisting of many glucose units connected together — are not. Therefore, there is a commonly used term that gives an approximate idea of how large these molecules can be: dextrose equivalence (DE). During processing, corn syrups are created through hydrolyzing (breaking down) starch with acid, enzymes, and heat to create various polymer distributions. Basically, the longer the starch is exposed to these elements, the more those longer chains are reduced to monosaccharides and disaccharides. The resulting product would be considered a higher DE corn syrup, with a value greater than approximately 43DE and with less viscosity, more sweetness, higher boiling points, and a lower water activity. Conversely, a DE below 43 would indicate a greater presence of longer chains and less of the monosaccharides and disaccharides. This syrup would have greater viscosity, less sweetness, more binding capability, and higher water activity. Polyols — like these traditional carbohydrates mentioned — also have weight (molecular weight) and follow similar trends. In turn, they can potentially offer the same colligative properties and viscosity as their sugar counterparts (Table V).

Table V. Molecular Weight

	Molecular Weight (g/mol)
Polyglycitol Syrup	Variable
Maltitol Syrup	Variable
Corn Syrups	Variable
Lactitol	362.3
Isomalt	344.2
Maltitol	344.2
Sucrose	342.0
Mannitol	182.0
Sorbitol	182.0
Xylitol	152.2
Erythritol	122.0

In baked goods, the molecular weight (MW) plays a significant role in dictating the overall appearance, texture, and functionality of the finished product. Why? Because the size of the carbohydrate (sugar, corn syrup, polyol, or fiber) used in a baked good influences the temperature at which the starch granule is hydrated during baking. This effect, in turn, causes the granule to swell, increasing the overall viscosity — due to gelatinization — of the batter or dough. It's this phenomenon, referred to as the "starch gelatinization temperature" (Ts), that gives us the familiar spread of a cookie or volume of a cake we are so accustomed to when baking with sucrose.

Generally, as the MW of the carbohydrate (sugar, corn syrup, polyol, or low-digestible carbohydrate) varies, so will the product's appearance and texture. Increases in MW typically result in greater spread or volume from higher Ts, while decreasing MW lowers the Ts, resulting in lesser spread or volume. This phenomenon is illustrated in Figure 3 and Table VI, where shortened cakes were made using the same base formulation and preparation parameters (see Formulation 1) while replacing only the sucrose with polyols of varying MW. Erythritol, with the lowest MW at 122.0 g/mole, demonstrated the densest cake followed by xylitol (152.2 g/mole), then sorbitol (182.0 g/mole). Isomalt and maltitol, which have a similar MW to sucrose at 344.0 g/mole, demonstrated similar volume and texture. The formulator needs to be aware of these effects when designing high-quality no sugar added, reduced sugar, and sugar free baked products that the consumer can enjoy and that meet the functional and nutritional demands needed from a production and marketing standpoint.

Typically, the best way to begin formulating no sugar added, reduced sugar, and sugar free baked products is to examine the sugars and corn syrups that are being replaced and match them with the polyols or other low-digestible carbohydrate. For instance, if an application were to use a 43DE corn syrup, it would be best to consider using a polyol such as a polyglycitol or maltitol syrup of similar MW instead of either a monosaccharide or disaccharide polyol. For most applications, this approach works well or is at least a good starting point. Today, there are many different types of polyols available that mimic traditional sugars and corn syrups, so formulators can usually find a good fit if they do their homework.

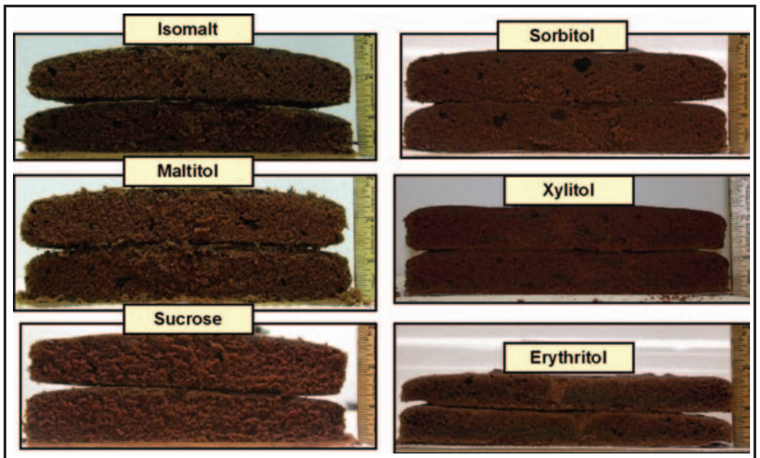


Figure 8. Effects of Molecular Weight on Cake Volume. Note as the molecular weight of the polyol increases, so does the cake volume.

Table VI. Height of Baked Shortened Cake With Various Polyols

	Cake Height (inches)
Sucrose	2.8
Maltitol	2.8
Isomalt	2.8
Sorbitol	2.5
Xylitol	2.25
Erythritol	1.75

Solubility.

Solubility is generally defined as the amount of a solute (sugar or bulking agent) that can be dissolved into a solvent (water) at a given temperature before becoming saturated. As the temperature of the solution increases, it can hold more of the solute. Therefore, if a saturated solution at a higher temperature is cooled to a lower temperature, eventually the solute will begin to fall out, typically in crystal form. Although this definition sounds very basic and fundamental, its implications in any food application are very complex. In the case of sucrose, its solubility allows it to deliver the sweetness and smooth mouthfeel we are accustomed to when it is consumed. However, the solubility of sucrose plays other important roles in baked products. First, it controls the way moisture interacts with other ingredients — such as flour and proteins like gluten — during batch preparation and baking, creating the characteristics of the finished sweet baked goods that consumers expect. Secondly, the solubility of sucrose allows it to bind water — acting as a humectant — subsequently increasing the shelf life of these products after they've arrived at the store.

With this information in mind, when recreating these products for sugar free formulation, it's imperative to understand the functional requirements of the application. Is it going to be a low-moisture system? Is it going to be a grained or crystallized product, such as an icing? Are there any handling, storage, or processing concerns? What is the expected shelf life of the product? Once the formulator knows the answer to these types of questions, he or she can have a better idea of where to start.

When examining the solubility of polyols, it is important to realize they can vary greatly (Table VII). For example, polyols such as erythritol, isomalt, and mannitol provide the lowest solubility and crystallize most readily. These attributes are advantageous for applications in the confectionery industry, such as fondants, crèmes, chewing gums, and chocolate; however, for the baked area they can prove to be limiting. In products needing rapid crystallization — such as an icing or cookie crème — these types of polyols would provide significant benefit based on their solubility alone. But in products like cakes, cookies, and sweet breads, they can't carry the full load of sugar replacement because of their solubility and often have to be combined with other low-digestible carbohydrates. If they were to be used as a full replacement, the finished product would tend to have a shorter shelf life — due to re-crystallization and staling — as well as noticeable changes to the finished texture.

Table VII. Solubility

	Solubility at 25°C (g/100g H20)
Sorbitol	235.0
Xylitol	200.0
Sucrose	185.0
Maltitol	175.0
Lactitol	140.0
Erythritol	61.0
Isomalt	29.0
Mannitol	22.0

Lactitol, maltitol, and xylitol, on the other hand, are more moderate in solubility and are most similar in solubility to sucrose. This means that their texture and flavor release will be most similar as well. These similarities allow them to be used in more traditional applications in the way that sucrose is used. Although these polyols all crystallize similarly to sucrose, lactitol seems to be the best match, followed by maltitol, then xylitol. In crystalline form, lactitol and maltitol are non-hygroscopic, while xylitol tends to be hygroscopic. If not properly stored, xylitol's tendency to pick up moisture can cause some handling issues in the form of clumping. However, this moisture-attracting attribute could also be an advantage in sweet baked goods, such as cakes and soft cookies, because it would help maintain a favorable texture, subsequently increasing shelf life.

One of the most soluble polyols next to glycerin is sorbitol, a monomer. Unlike sucrose, sorbitol's crystals are polymorphic, meaning it can have different structures. Today, the most common and stable crystalline form manufactured is called gamma sorbitol. Although the most stable, it is still hygroscopic and, like xylitol, can clump during storage if conditions are not properly controlled. Due to its hygroscopic nature and lower cost, it is commonly used as a humectant and plasticizer in various applications ranging from cakes and cookies to granola bars and specialty nutritional bars. A lesser-known attribute of sorbitol is its ability to control crystallization in sugar or sugar free icings and crèmes, extending their shelf life.

Maltitol syrups and polyglycitol syrups are very similar to corn syrups and, for the most part, are very soluble. They come in a range of percent solids levels (from 70% to 85%) and polyol distributions. These syrups are either used alone or in combination with other polyols — like erythritol, isomalt, maltitol, and lactitol — to control crystallization, improve processing, or improve textural properties of the finished baked product. Therefore, these syrups are used often in many sugar free applications that would traditionally use corn syrups.

Laxation and Polyols

Polyols have been an important part of sugar free confections for several decades. They have proven to be great formulation tools for reducing calories, lowering blood glucose responses, and formulating tooth-friendly confections. These same advantages also carry with them a caution: like fiber, polyols are low-digestible carbohydrates (LDCs). What is not absorbed in the upper gastrointestinal tract can, at certain levels, lead to osmotic imbalances or fermentation by bacteria, causing gas and loose stool.

It is important to understand that all polyols are not the same in terms of laxation. Table VIII shows the laxation thresholds for various polyols and some LDCs. These values represent the total amount of polyol or LDC that can typically be consumed daily before a laxation effect is observed. Understandably, these thresholds will vary for each person due to factors such as individual response, age, makeup of individual colonic microflora, gender, psyche, health, diet, drugs or antibiotics taken, and other foods consumed. Laxation is also dictated by chemical factors such as molecular weight (larger molecules will cause less osmotic imbalance), solubility, and whether or not the substance is absorbed in the small intestines. Some of these factors are also reflected in the grams/day number in Table VIII.

Table VIII. Laxation Thresholds

	Laxation (g/day)
Erythritol	125
Sucrose	>100
Polyglycitol Syrup	>100
Maltitol Syrup	>100
Maltitol	90
Fructose	70
Isomalt	50
orbitol	50
Lactitol	20-50
Mannitol	20

Considering all these factors, at what point are you, as a manufacturer, required to put an "excessive consumption may cause laxation" claim on a product's label? Currently in the U.S., manufacturers are only required to put such labels on products containing a certain amount of sorbitol, mannitol, and polydextrose. These trigger amounts are 20 g/d for mannitol (21 CFR 180.25), 50 g/d for sorbitol (21 CFR 184.1835), and 15 g polydextrose per serving (21 CFR 172.841). In the E.U., a trigger amount is expressed differently. Labeling is mandatory when polyol comprises 10% of the food product.

Although no other polyols are specified for a mandatory warning in the U.S., it is important to realize that these threshold values in Figure 11 are meant to give a general idea of the level of tolerance for a specific polyol per day. Consumption of any LDCs at levels more than 30 to 50 grams per serving is not recommended. Considering that most individuals will consume more than one serving size per meal, it might be wise to use the following guidelines:

- Less than 10 g/serving for monosaccharides.
- Less than 15 g/serving for disaccharides.
- Less than 20 g/serving for polysaccharides.

The key point: If used within sensible guidelines, polyols can improve a formulation without causing problems.

Understanding and Formulating Reduced Sugar, No Sugar Added, and Sugar Free Baked Goods

Suppose that as a product developer, your marketing department asks you to formulate a no sugar added, reduced sugar, or sugar free baked product. The first goal should be to establish which of these claims you can reasonably meet. For a product to be considered "sugar free," according to the Food and Drug Administration (FDA) 21 CFR 101.60(c)(1)(i), it must not contain more than 0.5 grams of sugar per serving of the finished product. However, this ratio may be difficult to achieve in making, for example, a sugar free fruit filling for a pie or cake (see Formulation 2). In this case, even if all the added sugars were replaced, the natural sugar (fructose) present in fruit filling could cause the finished pie or cake to be outside the requirement. Consequently, the finished product would have to be labeled, as defined by 21 CFR 101.60(c)(2)(i), "no sugar added." Reduced sugar products, on the other hand — which have been in demand recently — are typically the easiest to formulate because only a portion of the sugars are replaced. According to 21 CFR 101.60(c)(5)(i), there must be a reduction of only 25% in sugars per reference-serving size compared to the full-sugar equivalent to claim a product as "reduced sugar." Although only a portion of the sugars are replaced, the polyols should still be chosen carefully. If done so, they can partially replace the sugar exceptionally well with little or no change to the overall processing, sweetness, or functionality of the product.

Once you have identified which claim you can meet or choose to meet, the next step is to examine the role of the ingredients — in this case, sugars or corn syrups — you are going to reduce or replace in your application. In the shortened cake example used previously, sucrose primarily provides sweetness, mouthfeel, and texture, while its MW affects the height or volume of the cake by elevating the starch gelatinization temperature (Ts) and its solubility controls ingredient interaction and shelf life. In understanding these effects, the product developer can focus on the polyols or LDCs that demonstrate the quality and functional utility most similar to sucrose. By taking this approach and examining all of the physical characteristics mentioned above, the product developer can be more successful in creating a functional baked good that is high quality and that is not only good for the consumer, but tastes good, too.

Conclusion

Today, there are many more polyols for a formulator to choose from than there were 10 years ago. It is important to remember that understanding the properties of polyols can be related to understanding the properties of sugars and corn syrups. Consequently, by understanding the many physical properties of each, the formulator can make an informed decision about which polyols will provide the functional aspects needed for their reduced sugar, no sugar added, or sugar free baked good.

Example Formulations Chocolate Cake Formulation

	Percent (as is)
A. Sucrose*	26.70
Shortening	10.50
Spray-Dried Egg Powder	1.76
Water	17.40
B. Cake Flour	23.00
Cocoa Powder	6.99
Non-Fat Dry Milk Powder	2.34
Baking Soda	0.74
Salt	0.27
C. Water	10.00
Vanilla	0.30

*For each cake shown in Figure 8, each polyol (erythritol, xylitol, sorbitol, isomalt, and maltitol) was individually substituted for sucrose at the percentage listed in the formula above.

Chocolate Cake Procedure

Blend spray-dried egg powder and water thoroughly. Then combine the remaining ingredients of "A" together with the egg mixture in a Hobart bowl. Place bowl onto the Hobart mixer and, using a delta paddle, mix at speed #2 for 2 minutes. Next, add the ingredients in "B" to the contents of the bowl and mix for an additional 2 to 3 minutes on speed #2. Note: Occasionally scrape the walls inside Hobart bowl to ensure thorough mixing.

Add the ingredients in "C" to the bowl and mix for an additional minute. Remove from mixer and scrape walls of bowl.

Lastly, pour approximately 450.0 grams into an 8 inch round pan and bake at 350°F for 30 minutes.

Formulation 2 — "No Sugar Added" Pie Filling Formulation

	"Full Sugar" **Percent (as is)**	**"No Sugar Added"** **Percent (as is)**
A. Sucrose	30.0	----
Maltitol Syrup at 75% solids*	----	40.0
Blueberry (Whole Frozen)	47.0	47.0
Water	18.9	8.9
B. Modified Food Starch	3.95	3.95
Citric Acid	0.15	0.15
High Potency Sweetener	q.s.	q.s.
Total	100	100
Grams of "Carbohydrate" per 50 gram serving	20.0	20.0
Grams of "Sugar" per 50 gram serving	17.0	2.0
Grams of "Sugar Alcohol" per 50 gram serving	0.0	15.0

*In this formulation, maltitol syrup or polyglycitol syrup would provide the best overall functionality considering solubility, sweetness, and laxation threshold.

Blueberry Pie Filling Procedure

"No Sugar Added"
Combine **maltitol syrup** and **blueberries**, heat to 100°F.
Dry blend ingredients in "B," then add to "A" while continuously mixing.
Heat "AB" to 210°F or until desired consistency is reached.
Deposit into pie shell, bake at 350°F for 5 to 10 minutes.
"Full Sugar"
Combine **sugar**, **water**, and **blueberries**, heat to 100°F.
Dry blend ingredients in "B," then add to "A" while continuously mixing.
Heat "AB" to 210°F or until desired consistency is reached.
Deposit into pie shell, bake at 350°F for 5 to 10 minutes.

Corn Products U.S. SPECIALTY INGREDIENTS

Formulation 3 — "No Sugar Added" Chocolate Chip Cookie

Ingredients	**"No Sugar Added" Percent (as is)**	**"Full Sugar" Percent (as is)**
All-Purpose White Flour	31.31	31.31
Maltitol — Crystalline	22.13	----
Sucrose	----	22.13
Vegetable Shortening	18.95	18.95
Chocolate Chips — "Sugar-Free"	17.17	----
Chocolate Chips — "Full-Sugar"	----	17.17
Water (or less as desired)	7.34	7.34
Dried Whole Egg	2.05	2.05
Salt	0.41	0.41
Vanilla Extract	0.41	0.41
Baking Soda	0.23	0.23
Total	100	100
Grams of "Carbohydrate" per 33 gram serving	19.0	19.0
Grams of "Sugar" per 33 gram serving	3.0	13.0
Grams of "Sugar Alcohol" per 33 gram serving	10.0	0.0

Chocolate Chip Cookie Procedure

Pre-heat oven to 375˚F.
Hydrate **dry whole eggs** in **water**.

Blend **vegetable shortening** and **crystalline maltitol** — for "full sugar" formula use **sucrose** instead — together in mixer until well mixed (about 2 minutes on high speed). Scrape bowl.

Blend in **hydrated eggs** and **vanilla extract** while continuing to mix (2 minutes on low). Scrape bowl.

Dry blend **flour**, **baking soda**, and **salt**, then slowly add at a low mix speed setting. Blend for 1 minute, then scrape container.

Add "**sugar free**" **chocolate chips** — for "full sugar" formula, use "**full sugar**" **chocolate chips** instead — slowly to mixture at a low mix speed setting. Blend for 1 minute, then scrape container.

Drop by teaspoonful about 2 inches apart onto greased baking sheet. Flatten with greased glass bottom.

Bake 10 to 12 minutes until slightly brown in color around edges. Remove from sheet and cool on wire rack.

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