WHEY PRODUCTS AND LACTOSE IN CONFECTIONERY APPLICATIONS

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Dairy products have been used as valued ingredients by the confectionery industry for many years as they help to achieve the required flavor, color, and texture in many products including chocolate, coatings, caramels, aerated confections and toffee. Whey proteins are multi-functional food ingredients with a high nutritional value. They offer a wide range of functional properties that allow the development of new products and optimization of existing products with considerable cost savings. The nutritional value of whey proteins also makes them a highly valuable ingredient in confections.

Please consult local legislation regarding product standards and the permitted use of specific ingredients in your new product. All formulations are provided as start-up point for production development purposes and may require adjustments.

Nowadays, the United States dairy industry offers a successful range of functional dairy ingredients based on whey for application by confectionery companies worldwide.

Commercially, three major categories of products are used by the confectionery industry: sweet whey and modified whey products, whey protein concentrates (WPC) and whey protein isolates (WPI). Lactose and lactose derivatives are important whey-derived functional ingredients for the confectionery industry.

DAIRY INGREDIENTS IN CHOCOLATE CONFECTIONERY

Confectionery is the collective term applied to edible products usually compounded of sugar as a common ingredient. Candies are often combinations of several confections, with chocolate used as coating on candy bars, ice cream, cookies, and nuts.

Chocolate and chocolate confectionery together account for about 50% by volume and 60% by value of the confectionery industry worldwide. Internationally, the Codex Alimentarius provides standards for cocoa products and chocolate. Currently the standards are under revision by the joint FAO/WHO Food Standard Programme Codex Committee on Cocoa Products and Chocolate. Please refer to local regulations.

Milk, in its various forms, has been used as an ingredient in chocolate manufacture since the introduction of milk chocolate in 1876. As a major ingredient, dairy solids are essential to flavor, color and texture. They also provide nutrition and bulk, and contribute to gloss and shelf life. In the formulation of milk and white chocolates, several functional ingredients are used:

- Sweet whey, demineralized sweet whey and partially delactosed whey
- Whey protein concentrates
- Proprietary blends of the above components

The protein content of such ingredients is important because it is a key component in the Maillard reaction between amino acids and sugars. This reaction is important in caramel and toffee manufacturing, although it also takes place during the manufacture of milk chocolate.

Milk Chocolate (%)

	Standard	WPC-34*
Sucrose	47.53	47.53
Cocoa Butter	20.00	20.00
Non Fat Dry Milk	15.12	10.12
WPC-34	—	5.00
Butteroil	4.00	4.00
Cocoa Liquor (mass)	12.90	12.90
Lecithin	0.40	0.40
Vanillin	0.05	0.05

**See U.S. Whey Products Reference Manual or consult your U.S. whey products supplier for specifications.*

Milk Chocolate—Formula (%)

	Standard	Demineralized Whey—50%*	Demineralized Whey—90%*
Sucrose	45.25	45.25	44.75
Cocoa Butter	20.30	20.30	20.30
Whole Milk Powder (28% fat)	21.00	16.00	16.00
Demineralized Whey	—	3.60	5.00
Butteroil	—	1.40	1.40
Cocoa Liquor (mass)	12.90	12.90	12.00
Lecithin	0.50	0.50	0.50
Vanillin	0.05	0.05	0.05

**See U.S. Whey Products Reference Manual or consult your U.S. whey products supplier for specifications.*

FORMULATIONS

The level of milk solids non-fat in milk chocolate varies from 10 to 25%, although a lower limit of 14% applies in most European countries. According to European, Canadian, and Codex standards, functional dairy ingredients can be used to formulate milk chocolate in addition to milk and at a level not higher than 5% of total chocolate mass. This formulation practice has the following purposes:

- To develop specific or signature flavors during conching.
- To reduce manufacturing costs while maintaining high quality.
- To take advantage of the excellent functional and nutritional characteristics of many dairy based ingredients, i.e., whey-based products.
- To provide creamy-milky notes to the finished product.

Recently, conching mechanisms to reduce conching time and avoid agglomeration have been developed leading to the use of new equipment and shorter conching times. The addition of functional whey-based ingredients to a milk chocolate formulation improves the efficiency of the Maillard reaction, yielding better chocolate taste and mouthfeel.

The selection of the optimal whey-based ingredient should be determined by taking into consideration:

- The nature of the final application from solid base vs enrobing chocolates.
- The desired effect of the ingredient on chocolate functionality and rheology.
- The desired contribution to a specific flavor profile, such as caramelized and toffee notes.
- Cost Constraints.

In general terms, replacing milk solids with whey-based ingredients at a 5% level, can produce savings of 8 to 14% on milk powder costs while maintaining a high quality end-product.

WHEY PRODUCTS AND LACTOSE IN COMPOUND COATINGS

Chocolate-flavored compound coatings provide an alternative to real chocolate. Other vegetable fats are substituted for the cocoa butter. Compared to chocolate, the resulting products can be less expensive or easier to handle. Sensory quality would not match that of pure chocolate but allows more flexibility in terms of new and novel textures and applications.

Ingredients used in compound coating formulations include: sugar, chocolate liquor (mass) and/or cocoa powder, vegetable fat, dairy components, and lecithin.

Whey protein-based ingredients are used as a milk solids source in the formulation of milk chocolate flavored coatings for ice cream, candy bars, and other enrobing applications replacing skim milk powder.

Demineralized whey (50, 90%), whey protein concentrates, and blends are used as total or partial replacement for milk powders in coating formulations.

Reduced-calorie and reduced-fat coatings offer an unique opportunity to use whey based dairy ingredients for flavor enhancement. Reduced calorie fats have fast crystallization rates but minimal contraction. For this reason, these coatings are best employed using powder-type recipes in enrobing applications.

Milk Chocolate Compound Coatings—Formula I (%)

	Tempering		Non-Tempering
Sugar	48.82	44.12	44.59
Vegetable Fat (CBE)	27.00	28.00	—
Vegetable Fat (CBR)	—	—	35.00
Chocolate Liquor (mass)	—	11.20	—
Demineralized Whey (50%)	7.00	7.00	7.00
Whey Protein Concentrate 34%	7.00	7.00	7.00
Cocoa Powder (12% fat)	7.50	—	6.00
Butteroil	2.00	2.00	—
Lecithin	0.50	0.50	0.30
Vanillin	0.12	0.12	0.05
Salt	0.06	0.06	0.06

White Chocolate Compound Coatings—Formula II (%)

	Tempering	Non-Tempering
Sugar	50.00	49.50
Vegetable Fat (CBE)	38.00	—
Vegetable Fat (CBR)	—	40.00
Lecithin	0.30	0.35
Vanillin	0.10	0.15
Demineralized whey	5.00	5.00
Whey protein concentrate 34%	5.00	5.00
Butteroil	1.60	—

Reduced Calorie/Fat Compound Coatings

	%
Sucrose	30.00
Polydextrose-Litesse II*	20.40
Skim Milk Powder	6.00
Whey Protein Concentrate 34%	6.00
Lecithin	0.40
Sorbitan Monoestearate**	0.10
Benefat I*	30.00
Vanillin	0.10
Cocoa Powder (0.5% fat)	7.00

**Litesse II and Benefat I are from Cultor Food Science*
***Sorbitan Monoestearate is used to inhibit bloom*

WHEY PRODUCTS IN SUGAR CONFECTIONERY

It is the combination of the multiple of ingredients and processing options that allows the confectioner to manipulate chemical and physical interactions to produce a wide range of confectionery products.

The range of textures which can be achieved in confectionery is diverse, spanning from hard (high boils) to soft (nougats, marshmallow) and from snappy (chocolate) to chewy (caramel). The major ingredients which contribute to these characteristics are sugars (including sucrose, invert and glucose syrups), fats and proteins. Dairy components provide protein and play a critical role in the formulation of caramels, aerated confections, health bars, and dulce de leche (a popular South American delicacy with increasing worldwide appeal).

CARAMEL AND TOFFEE

Both caramel and toffee have the same ingredients, the difference between the two is that the final moisture content is less in toffee than in caramel. Toffee has 3 to 6 percent moisture and is generally darker, whereas caramel has 6 to 12 percent moisture and is lighter in color.

Caramel is one of the most versatile and widely used confectionery products. Caramel in its many forms is consumed as an item, enrobed or used as a component in combination with cookies, nougat, marshmallow, etc.

Ingredient factors influencing the Maillard reaction, and therefore the flavor, color and texture of caramels, are:

SUGARS — TYPE AND RATIO

The amount and type of reducing sugars contribute differently to the browning reaction with monosaccharides being more reactive than disaccharides. The composition of the dairy components in a caramel formulation influences the browning reaction due to the difference in the amount of lactose, a reducing disaccharide, present in dairy ingredients.

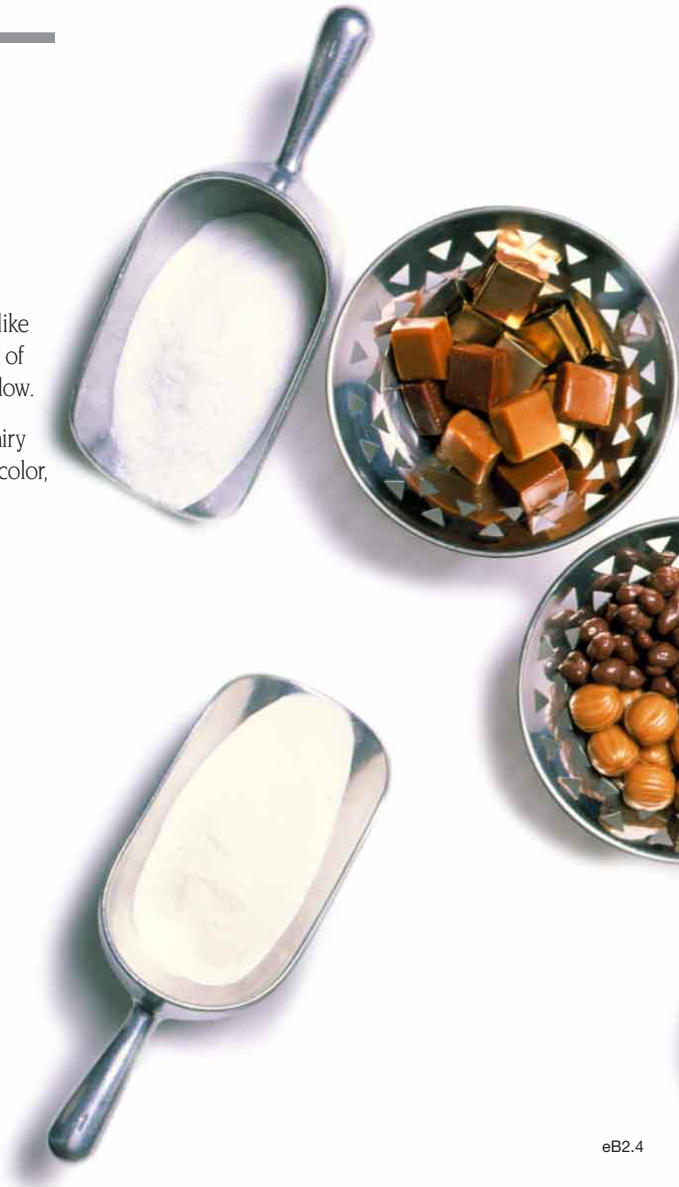
AMINO COMPOUNDS — TYPE AND RATIO

Different dairy ingredients are used to formulate caramels. It is important to balance the formulation, taking into consideration the type and amount of protein present. Whey protein concentrates offer a cost-effective alternative to formulate caramels with good eating quality and excellent processability. In certain applications, like standup caramels, a minimum amount of casein is also needed to prevent cold-flow.

As a general role the highest level of dairy solids in caramel, the better the flavor, color, and standup qualities.

FATS

Fat-based ingredients used in the formulation of caramels influence texture, mouthfeel, and shelf life of the finished product. Fats are used as a flavor carrier, stickiness reducer, machinability assistance and standup quality. While the amount of fat can vary from 5 to 20 percent of the formulation, 10 to 12 percent fat is typical.



DAIRY INGREDIENTS AND CARAMEL PROCESSING

It is advisable, that powdered dairy ingredients (skim milk solids, demineralized sweet whey and WPC) be reconstituted with warm water (50 to 60°C), preferably in an homogenizer prior to addition to the cooking vessel. Pre-blending of the dairy powder with some of the formulation sugar will also prevent lumping during the recombination process. If no homogenizer is available, the dairy ingredients can be reconstituted in the following manner. Place a predetermined amount of warm water heated to 72°C in a vessel. Slowly add the blended dairy powders with enough agitation to give the solution a creamy consistency. Mix for at least 15 to 20 minutes. If the recombined dairy blend shows sign of curdling, it is advisable to add a stabilizer, usually disodium phosphate at a level of 0.01 to 0.05% of the total protein.

Caramel Center for Moulded Shells (Typical final moisture 10%)

	Control	Variant I	Variant II
Corn Syrup (42 or 62 DE)	50.00	50.00	50.00
Sugar, Granulated	15.00	25.00	25.00
Sweetened Condensed Whole Milk	22.30	—	—
Sweet Whey	—	—	2.00
WPC-34	—	6.20	4.20
Vegetable Fat	2.00	2.00	2.00
Butteroil	—	1.40	1.50
Mono- & di-glycerides	0.10	0.10	0.10
Vanillin	0.20	0.20	0.20
Salt	0.40	0.10	—
Water	10.00	15.00	15.00

Standup Caramel (Typical final moisture 10%)

	Control	Variant I	Variant II
Sugar, Granulated	31.20	37.17	30.00
Corn Syrup (42 DE)	26.65	26.65	30.30
Sweetened Condensed Whole Milk	28.40	14.20	—
Demineralized Whey	—	3.74	—
WPC-34	—	—	6.70
Skim Milk Solids	—	—	6.70
Partially Hydrogenated Vegetable Fat	12.27	12.20	8.00
Butteroil	—	1.00	1.00
Water	—	3.85	16.20
Lecithin	0.79	0.79	0.70
Vanillin	0.20	0.20	0.20
Salt	0.49	0.20	0.20

Free Flowing Caramel for Layers in Candy Bars (Typical final moisture 15%)

	Control	Variant I	Variant II
Corn Syrup	45.00	45.00	45.00
High Fructose Corn Syrup 55	5.00	5.00	5.00
Sugar, Granulated	15.00	19.40	21.60
Sweetened Condensed Whole Milk	22.30	11.00	6.00
Sweet Whey	—	—	1.40
WPC-34	—	3.20	3.20
Vegetable Fat	2.00	2.00	2.00
Butteroil	—	1.00	1.20
Mono- & di-glycerides	0.10	0.10	0.10
Vanillin	0.20	0.20	0.20
Salt	0.40	0.10	0.10
Water	10.00	13.00	14.20

WHEY PRODUCTS IN AERATED CONFECTIONERY

AERATED PRODUCTS

Malted milk balls are an example of such a product. The ingredients used in the formulation consist of mainly corn syrup, sugar, protein, flavor and color. The quality of the ingredients is critical as relates to the formation of the air bubbles. Whey powders including 50% demineralized powders are used as protein bulking agents in the formation of this kind of confectionery. A minimum of 10% protein in the whey is critical to avoid product texture collapse after vacuum processing.

Stability of the aerated confection is obtained by the presence of high molecular weight foaming agents. They prevent air bubbles from disappearing or growing too large in size, and then collapsing. Foaming agents create a protein network within the foam that helps stabilize the final structure. That semi-rigid protein network is present in the syrup or continuous phase of the confectionery which surrounds each of the air cells.

Common aerating proteins used in the formulation of aerated confectionery are gelatin, soy, and modified dairy proteins. Within the last category, partially denatured WPCs (80% protein) and partially denatured WPIs (>90% protein) offer a cost-effective alternative to the confectionery manufacturer when used in combination with the other aerating agents. In addition, partially hydrolyzed WPIs have been proven to provide interesting functionality.

NOUGAT

Nougat is an aerated high boiled syrup-containing fat that has been stabilized by the addition of a whipping agent. The production of nougat can be adjusted to give a range of textures that can vary between a long-eating, chewy, non-grained product and a short-eating, soft, fine-grained product.

Either a batch or continuous method can produce nougat, but the batch process is considered a far superior system in terms of flexibility of production, texture consistency, the ability to absorb rework, and the appearance after cutting.

The batch process consists of boiling water, sugar, and a corn syrup under vacuum to a moisture content of about 8% at a temperature of 120°C. The vacuum cooker is used not only to reduce the time of boiling but also to produce a cooked syrup at a lower temperature—the higher the temperature, the longer the beating time.

The vacuum-cooked syrup is transferred to a robust and powerful atmospheric whipping machine that can operate at two speeds, low for mixing and blending and high for aerating. A whipping solution (gelatin, milk proteins, WPC, WPI) is blended into the cooked mass before being aerated at high speed, when the density is reduced to 0.6 g/ml. A small quantity of icing sugar is blended into the aerated product at low speed to induce graining.

Nougat Formulation

	Control %	Variant I %
Part I—Frappè		
Egg White Solids	8.65	5.69
Partially denatured WPI—90% protein	—	3.00
Sugar 6x	10.61	10.61
Water	7.07	7.07
Salt	0.13	0.13
Part II—Syrup		
High Fructose Corn Syrup	22.77	22.77
Sugar, Granulated	28.46	28.46
Water (loss from boiling—12–13%)	11.38	11.38
Part III—Additional Ingredients		
Sugar, 6x	17.39	17.39
Cocoa Powder (10–12% fat)	3.24	3.24
Non-Fat Dry Milk	0.60	—
WPC-34	—	0.60
Vegetable Fat	1.87	1.87
Flavor	0.19	0.19

WHEY PRODUCTS IN NUTRITION BARS

Nutrition bars are showing the fastest and most explosive growth in the sports nutrition market. Nutrition bars are baked or extruded with textures ranging from that of brownies or cookies to a chewy/nougat like texture.

Dairy proteins have a special place in the formulation of these products. Because of good functionality and also excellent nutritional characteristics, whey derived ingredients play a critically important role when a nutritional bar is formulated. High protein whey protein concentrates WPC80 and whey protein isolates (90% protein) are key elements in the formulation of these bars. WPI and hydrolyzed whey protein isolates also provide a balanced amino acid profile.

The sensory characteristics of nutrition bars such as appearance (smoothness and shininess), texture (flexibility, firmness, moistness, graininess, stickiness, chewiness, mouthfeel, and chalkiness), and positive or negative flavor attributes (protein, vitamin, milky, bitter, wheaty, stale) can all be effected by the ingredients used, especially the source of protein. Generally speaking, WPCs and WPIs offer blander, milkier flavor profiles much preferred by consumers over those provided by soy protein, with its wheaty, beany notes or egg albumin, which can contribute a moderate stale taste or caseinates.

The type of protein used in the formulation notably affects texture. Bars made with dairy proteins, especially WPIs, are more pliable and moderately firm, while slightly less chewy than bars made with other protein sources.

Comparison of nutritional characteristics of different proteins

	PDCAAS	PER	NPU
Whey Protein	1.00	3.2	93
Casein	1.00	2.5	75
Soy	0.99	1.8	66
Corn	0.42	1.2	52
Wheat	0.42	1.0	52

PDCAAS = Protein Digestibility Corrected Amino Acid Score;
PER = Protein Efficiency Ratio;
NPU = Net Protein Utilization

Nutrition Bars

	Variant I (%)	Variant II (%)
WPI (90% Protein)	32.00	—
Milk Minerals*	2.00	2.00
Soy Protein Isolate (90% Protein)	—	16.00
WPC (80% Protein)	—	18.00
Citric Acid	0.35	0.35
Lecithin	0.40	0.40
Sorbitol	9.25	9.25
Vegetable Fat	7.00	7.00
Fructose	16.50	14.50
Figs	5.83	5.83
Corn (42 DE)	23.92	23.92
Corn Flakes	2.55	2.55
Water	5.50	5.50
Flavor	0.20	0.20

*Milk calcium and high calcium/lactose-reduced whey products can be used. Please consult syour U.S. whey ingredient supplier for additional information.

Procedure:
(1) Mix the dry ingredients
(2) Mix the lecithin in the melted fat phase
(3) Knead the fat phase with the dry ingredients
(4) Add and knead the liquid phase, add flavor, if any
(5) During the process the kneading temperature must be 40–42°C
(6) Form the kneaded mass into bars
(7) Coat with chocolate or compound coating

WHEY PRODUCTS IN DULCE DE LECHE

Dulce de leche is a dairy-based confectionery product immensely popular in Latin America. Its delicate flavor, smooth texture, and nutritive value, make dulce de leche an irresistible delicacy. There is no translation of its name into English, although it has been referred to as "dairy spread" or "milk jam."

In general, dulce de leche is prepared by boiling whole milk with added sucrose until a 70% (wt./wt) total solids product is obtained. Sucrose usually is partially replaced with glucose syrup to prevent crystallization. Due to the prevailing conditions during preparation (temperature-time, pH, reactant species) non-enzymatic browning reactions occur extensively, leading to a brown-colored product that has a characteristic and pleasant flavor. Sodium bicarbonate is added to raise pH to increase browning development and prevent protein coagulation. The high solute concentration of dulce de leche results in a water activity usually below 0.85 which constitutes the main preservation factor in this product.

Two distinct types of dulce de leche are produced. The "casero" (for use at home) is shiny, of a reddish brown color and slightly stringy while the "pastelero" (for confectionery, bakery and other industrial uses) is lighter in color and very short in texture to avoid running off from cakes, pastry, and other confectionery products.

Industrial use of dulce de leche has been expanding in recent years. Nowadays it is used as a raw material in the manufacture of dairy caramels, fudge, filled bonbons and solid tablets. It is also used as a filling in ice cream, ready-to-eat pastries and cakes. Dulce de leche flavors are used by manufacturers in ice cream, puddings, cake icings, and yogurt. Although many applications of this product are already being commercialized by local and global food manufacturers, the potential exists for new and novel uses in confectionery, ice cream, bakery, and other applications.

PRODUCTION CONSIDERATIONS

Several conditions must be maintained before, during and after processing to manufacture a dulce de leche of good sensory, microbial, and textural quality.

The most critical technological problem in dulce de leche production is the prevention of lactose crystallization. Milk is concentrated during production to a ratio of 2.5:1 resulting in a saturated lactose solution which progressively crystallizes. Lactose crystallization causing a sandy texture lowers product acceptability. Crystals are so hard that consumers refer to them as sand or ground glass. Various approaches have been directed toward controlling this phenomenon.

ALTERNATIVE DAIRY INGREDIENTS

Whey based dairy ingredients can be used as a cost-effective tool to replace milk solids and produce alternative formulations for dulce de leche with consumer appeal. Best suited whey ingredients for this application are WPCs with a protein content of 34 to 40%. Depending on the manufacturing process and formulation, it may be necessary to adjust processing conditions to account for the difference in protein composition between milk and whey. A starting recommended level of milk solids replacement is 25%. In general, with up to 50% solids replacement with a WPC34, no processing or formula adjustment is necessary. At higher replacement levels, the consistency, rheology, flavor and color of the finished product would be effected in such a way that major changes in formulation and processing would be needed.

In formulations already using a combination of fluid milk and skim milk solids, the latter ingredient could be replaced 100% with a WPC (34% protein) without changes in processing conditions. It is advisable that powdered dairy ingredients, i.e., skim milk solids, WPC, be reconstituted with warm water (50 to 60°C), preferably in an homogenizer prior to addition to the cooking vessel. Pre-blending of the dairy powder with some of the formulation sugar will also prevent lumping during the recombination process.

If no homogenizer is available, the dairy ingredients can be reconstituted in the following manner. Place a predetermined amount of warm water heated to 72°C in a vessel. Slowly add the blended dairy powders with enough agitation to give the solution a creamy consistency. Mix for at least 15 to 20 minutes.

WHEY-BASED INGREDIENT FORMULATIONS

Dulce de leche for confectionery and bakery use

	Formula #1	Formula #2	Formula #3
Fluid whole milk, Liters	700	700	—
WPC-34, Kg	75	75	110
Sweet Whey, Kg	75	75	110
Water	—	—	750
Sugar, Kg	400	0	400
Cream, 60% fat, Kg	67	67	100
Glucose Syrup, 82Brix, Kg	70	—	70
HFC Syrup, 42%, Kg	—	180	—
Sodium Bicarbonate, g	100	100	100
Vanilla extract, Liters	0.25–0.35	0.25–0.35	0.25–0.35
Agar, Kg	1.25	1.5	1.5

Product Yield: 925 Kg @ 72–74% total solids

Dulce de leche casero

	Formula #1	Formula #2
Fluid whole milk, Liters	500	500
WPC-34, Kg	150	—
Demineralized Whey, Kg		65
Sugar, Kg	360	360
Cream, 60% fat, Kg	75	—
Glucose Syrup, 84Brix, Kg	260	260
Sodium Bicarbonate. g	100	100
Vanilla extract, Liters	0.3-0.6	0.3-0.6

Product yield: 1000 Kg @ 69–70% total solids

Dulce de leche for ice cream use

	Formula #1
Fluid whole milk, Liters	1000
WPC-34, Kg	100
Sugar, Kg	400
Cream, 60% fat, Kg	50
Glucose Syrup, 84Brix, Kg	125
Sodium Bicarbonate. G	1000
Vanilla extract, Liters	0.3-0.6

Product Yield: 1000 Kg @ 70–71 Brix

The nutritional and functional benefits of using whey in a variety of foods, including confectionery products, is extremely valuable.

Whey and whey-based ingredients are an important and economical source of lactose, minerals, protein and vitamins.

Advances in technology and process design have significantly improved the overall quality of highly refined whey-based products, including demineralized whey, whey protein concentrates, and whey protein isolates.

Whey-based ingredients have many desirable qualities of great importance to the manufacturer of confectionery products: good rate of solubility over a wide range of pH levels, water binding capacity, gelation properties, ability to emulsify with fats, enhanced whipping and foaming performance and improved viscosity and texture.

Recommended use levels of whey proteins in confectionery applications

	RECOMMENDED USAGE LEVEL						
Product	**Sweet Whey**	**Demin. Whey**	**WPC-34**	**WPC-80**	**WPI-90**	**Lactose**	**Expected Benefit**
Milk Chocolate (1)	—	0–5%	0–5%	—	—	3–7%	Cost benefit Flavor development Color improvement
Compound Coatings (1)	—	0–20%	0–20%	—	—	3–7%	Cost benefit Flavor development Color improvement Functionality
Caramel (1)							Cost benefit
• Standup	0–4%	0–4%	0–7%	—	—	—	Flavor improvement
• Cast	0–2%	0–2%	0–5%	—	—	—	Color development
• Free Flowing	0–2%	0–2%	0–5%	—	—	—	Texture modification
Nougat (1)	—	—	0–1%	—	0–3%	—	Cost benefit Better quality Better texture Better shelf life
Dulce de leche (2)	—	0–50%	0–50%	—	—	—	Cost benefit Improved color Improved flavor Signature flavor development Functionality
Nutrition Bars (1)	—	—	—	0–20%	0–35%	—	Nutritional quality Functionality

(1) % of final formula, (2) % of total milk solids nonfat

Q: *Will the addition of demineralized whey to milk chocolate or compound coatings affect its shelf life?*

A: No, the addition of a good quality demineralized whey into milk chocolate will not affect shelf life. However, flavor and color of the chocolate or compound coating will be affected if whey levels exceed 25% of the formulation.

Q: *Can sweet whey give a gritty or grainy texture in caramels and toffees? How could this be avoided?*

A: Yes, gritty caramel could be produced if the crystalline lactose present in the whey is not totally dissolved during processing. The insoluble lactose crystals will act as seed agents and the product will crystallize during storage. To solve the problem, the whey-based ingredient should be dissolved first in water preheated to at least 72 to 82°C.

Q: WPC 80 *can replace egg white in some products. Which ones are best suited?*

A: In aerated confectionery, partially denatured WPC 80 could be used in combination with gelatin to replace egg white.

Q: *After cutting caramels they lack body and flatten out. Why?*

A: Probably the formulation does not contain enough milk solids. Increase protein level. In addition, reformulation of the syrup phase could help too.

Q: *My caramel is too thick and has poor elasticity. Could this be due to the use of* WPC *or sweet whey?*

A: Thickness of the caramel is probably not due to the whey component used but to the corn syrup selected for the formulation. Changing corn syrup or using a corn syrup blend with less polysaccharide will help reduce viscosity. The elasticity could also be related to the carbohydrate profile or the syrup phase or could be related to a low concentration or even no casein being present. Again, this problem could be solved by reformulating the syrup phase or by adding additional casein in the form of milk solids.

Q: *Is demineralized whey recommended in a nougat formulation?*

A: Generally no. In nougat applications good whipping and foaming properties are needed. Both are higher in WPC 80 or a WPI. Demineralized whey could be added at low levels (1% of the formulation) as a milk replacement to add some dairy notes to the formula if that is desirable.

Q: *My vacuum aerated centers are not expanding during process. Could this problem be related to my formulation? Why?*

A: Yes, your formulation may be responsible for this problem. The demineralized whey should have at least 10% protein to prevent this from happening.

Q: *While using a* WPC*/milk solids non fat formulation in the production of caramel, I experienced an unacceptable curdling. How could this be avoided?*

A: First check the pH of your product. Sometimes a stabilizer needs to be added to prevent curdling of the proteins that lead to a grainy texture. Usually, di-sodium phosphate solves the problem at very low usage level.

J. Bouzas and B. D. Brown, 1995, *Ingredients Interactions, Effects on Food Quality*, (A. Gaonkar, ed.), Marcel Dekker, Inc., New York, p. 451.

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