Whey—A Low-Cost Dairy Product for Use in Candy

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Abstract

Milk and its products are basic ingredients in many confections. Whey, a highly nutritious dairy product with important functional uses in certain candies, is the least expensive of the dairy products commonly available for confectionery use. The price of whey solids may be 25–40% less than the price of nonfat milk solids. Although whey contains half of the solids of milk, fat and casein having been removed in the manufacture of cheese, the residue generally has not been prepared for confectionery use because of certain problems inherent in the cheese industry. Only recently, as cheese manufacture was consolidated and as cheese was produced in large factories, has sufficient whey become available to make processing of it economical. Furthermore, whey contains most of the sugar (lactose of milk) and this has made it difficult to dry or prepare in suitable concentrated form. Recent processing innovations have overcome this latter problem.

Milk is composed of four basic constituents that need to be considered in candy processing. These are milk fat, milk protein, milk sugar, and milk minerals or ash. The composition of fluid wheys and of products suitable for candy manufacture, sweetened condensed whey and dried wheys, is given in Table 1.

Fluid wheys, because of their high water content, cannot be used easily for candy manufacture. Sweetened condensed whey is excellent for candy usage, but it contains a large amount of sucrose, is heavy and bulky, and the whey solids can sometimes be more economically obtained as dried whey.

Milk sugar or lactose is the principal component of whey and is unique in several respects. It is much less soluble than sucrose and can be used to form a crystalline structure in fudge. If the lactose content of candy is below about 3%, its crystalline-forming habit may be ignored. If a candy contains 5-10% or more lactose, consideration should be given to getting it into a permanently stable crystalline state. To do this we resort to forced crystallization, a procedure to induce the formation of small uniform-size crystals which will ensure shelf stability. A fudge containing a high lactose concentration should be cooled after cooking to as low a temperature as possible, but not so low that adequate handling fluidity is sacrificed. After cooling, sugar fondant may be beaten into the mass and the fudge poured to set. A few ounces of lactose seed may be used to start crystallization in place of the fondant, to aid in graining the fudge. Actually, best results can be obtained through the use of a small quantity of a lactose fondant made by crystallizing pure lactose in an inverted sugar sirup.

If a considerable quantity of milk sugar is used in caramels, graining of the lactose is undesirable and may be retarded during storage of the candy. This is accomplished by subjecting the whey component to the full heat treatment given the caramel ingredients. Care is taken not to seed the mixture after pouring, as this would encourage lactose crystallization.

The protein of whey is the water-soluble protein which remains after the casein is removed in cheese-making. When heated, whey protein forms a soft flocculent coagulum less capable of

TABLE 1

Composition of Whey Products

Products	Water	Protein	Fat	Milk sugar	Ash	Lactic acid	pH	Sucrose
	(%)							
Fresh fluid wheys								
Sweet rennet whey	93.2	.8	.6	4.7	.5	.2	6.1	....
Cottage cheese whey	93.6	.8	.2	4.3	.6	.5	4.7	
Dried wheys								
Sweet rennet whey	4.0	12.5	1.0	72.0	8.0	2.5	5.7	....
Cottage cheese whey	3.5	12.9	.3	67.	8.5	7.8	4.4	
Sweetened condensed whey (2)	24.	5.3	.6	28.6	3.5			38.

contributing structural firmness to candy than is casein. But the whey protein surpasses casein in foaming characteristics. At high concentration and viscosity, such as may be found in sweetened condensed whey, a moderately stiff foam of good stability can be formed. A whipped whey or milk albumin foam cannot be set by heat, a property unique with egg white. Whey proteins, although present in whey in relatively small quantities, surpass even the casein of milk in nutritive value.

Milk salts have an important bearing on the physical dispersion of the milk proteins, but it has not been shown that this carries through to the candy mixture. Milk salts contribute in an important way to the characteristic flavor of milk and, no doubt, they also affect candy flavor. The candy manufacturer does not buy milk salts as such, but takes the measured quota in the whey.

Preparation of Whey for Use in Candy

Sweetened condensed whey was developed to fill a need for a simple and inexpensive method of preserving whey for food manufacture (2). Sweetened condensed whey is perhaps still the the perferred source of whey solids for candy, where smooth, easily blended, free-flowing ingredients of milk flavor-transfer characteristics are desired. The whipping properties of fat-free, sweetened condensed whey may be of interest in the manufacture of special aerated types of candy. It should be emphasized that to whip sweetened condensed whey, all fat must have been removed from the fluid whey before concentration. At room temperature this product may be whipped to 200% over-run in 3 to 4 min. The whip will stand without drainage for many hours, but it will not set with heat. It may be used to introduce air into a cooked, partially cooled candy mixture or sirup base. The stiffening mixture entraps and holds the air. Sweetened condensed whey foam is not stable, and to retain air it must be folded into the cooling candy mass so that the mixture will set before it can collapse. With care and understanding of the mechanism involved this can be readily accomplished.

Dried whey products have the advantage over fluid products in their reduced bulk, ease of handling, and lack of excess water which must be boiled off in the cooking of candy. Dried whey is stable at room temperature storage, but it must be held in the absence of moisture. Dried whey preparations vary considerably in their ability to absorb moisture. If moisture is absorbed, the lactose in the whey will usually crystallize, and this causes the product to form a hard cake. The presence of the moisture also promotes development of a stale flavor. Dried whey is usually made so that it has a minimum of hygroscopic properties. It is usually packaged in polyethylene-lined bags and should be stored in a dry place.

Since whey results from cheese-making, it retains some of the special flavor characteristics associated with the cheese-ripening process. Whey has a tendency to accentuate other flavors present; whereas, nonfat milk solids may have somewhat of a masking effect. Whey, because of its high lactose content, usually imparts a golden color upon heating, which would not be expected to the same extent from nonfat milk solids.

Whey of two types is produced by cheese manufacture. Sweet rennet whey, the product arising from the manufacture of Cheddar, Swiss, or other sweet types of cheese, contains a relatively small amount of acid which is developed by the starter added to the milk. When sweet whey is drawn from the cheese curd its acidity is about pH 6.2. Until recently, the dried whey of commerce was sweet, rennet cheese-whey produced by concentrating and drying to a moisture content of about 12%; holding this moist, rather plastic mass up to 30 min to allow the lactose to crystallize; then drying and grinding it to produce an excellent grade of non-hygroscopic powder suitable for food use.

A second type of whey is Cottage cheese whey, which until very recently had not been processed for use in food preparation. Cottage cheese whey is now being dried by a method called foam-spray drying. The product has the characteristics shown in Table 1.

In drying Cottage cheese whey, the fresh whey is pasteurized and concentrated under vacuum to 45-50% solids and immediately spray-dried. Because of its high acid content, Cottage cheese whey has always been very difficult to dry. The key to the success of the foam-spray-drying method is the injection of a gas into the high-pressure feed line going to the spray nozzle (1). Injection of gas expands the normal spray droplet, increasing its surface and lowering its density. The buoyant particle appears to remain longer in the drying air than the unexpanded particle with comparatively less surface. When the foamed particle is dried, it exhibits excellent flow characteristics in the conduits and passages of most dryers. The dried powder has less tendency to adhere to the surface of the equipment than the un-gassed particles. This always presented a problem when gas was not used to expand the droplet.

When air is used as the expanding gas, a powder of relatively low density is obtained.

TABLE 2
Whey Candy Formulas (4)

Ingredients	Wheyfer ingredients	Whipped-fudge ingredients	Fudge ingredients	Caramel ingredients	Taffy ingredients
			(*lb*)		
Sweetened condensed whey (2)	84	32	43.0	45	52
Sugar		40	11.0		
Corn sirup		16	9.0	28	42
Invert sirup		5	3.0	6	
Skimmilk solids				6	
Hardened vegetable fat				4	
Milk fat (as butter or cream)			2.5	5	
Precooked dry cereal	4				
Fondant			20.0		
Chocolate		7	6.0		6
Powdered lactose (for seed)			.1		
Nuts (optional)	12		5.4	6	
Vanilla to flavor					
Total weight of ingredients	100	100	100.0	100	100

The percentages of total candy solids derived from whey are: for wheyfers, 40%; whipped fudge, 14%; fudge, 20%; caramel, 21%; taffy, 26%.

This density may be as low as 0.25, compared to 0.5 for conventionally dried whey. This, of course, doubles the packaging materials needed to package a given amount of product. Greater density can be obtained by the injection of liquid carbon dioxide in place of air (3).

The foam-spray-dried wheys are resistant to moisture absorption, although the lactose in the whey is not crystallized before the product is spray-dried, nor is it crystallized during the drying process. The unusual conformation of the foam-spray-dried particle appears to account for its lower water absorption, which is less than when the particles are made without the injection of gas during drying.

Since Cottage cheese whey is highly acid, the acid must either be neutralized or used in the food in which the whey is to be an ingredient. The candy formulas given here employ sweet rennet whey. If Cottage cheese whey is to be used in the formula, its acid must be neutralized either before or after drying. Neutralization may be accomplished by addition of sodium or calcium hydroxide. The pH need not be raised above 6.0. Care should be taken not to over-neutralize. In no case should the pH be allowed to exceed 6.5.

How to Make Whey Candy

The formulas in Table 2 are calculated for the use of sweetened condensed whey as the source of whey solids (4). Plain condensed or dried whey may be substituted for the sweetened condensed product which contains 38 to 40% whey solids and an equal quantity of sugar. When sweetened condensed whey is not used, the quantity of sugar normally included in it may be mixed with the plain condensed or dried whey before these are added to the candy batch. Wheyfers and whipped whey fudge require fat-free sweetened condensed whey for their manufacture. Since sugar aids in the wetting of dried whey, sugar-dried-whey mixtures should be prepared and dispersed in water at room temperature. The whey-sugar solution may then be added to the candy mass.

Fudge, caramel, and taffy (Table 2) should be cooked in a kettle having a fast double-action stirrer. Water may be added before cooking, if necessary, to insure proper mixing. The coagulum formed by whey protein is soft and flocculent. It requires no special treatment during cooking and it disperses well in the candy mixture. When whey is the only source of milk protein, there is no tendency to develop curd lumps or an irregular rough texture as is sometimes caused by casein coagulation when skimmilk is used.

Wheyfers (Table 2). Whip the sweetened condensed whey in a mechanical beater for 5 min or more until its volume is at least doubled. Addition of materials containing fat or oil must be avoided, since they destabilize the whip. Spread the nuts on fine-mesh-screen drying-trays. Carefully fold the cereal into the whipped whey and extrude the whip on the screen in ribbons 1¼-in. wide and ¼-in. thick. Dry the mixture in a tunnel dryer at 210 F for about 1 hr. Drying time will depend upon temperature, air circulation, and thickness of the candy. Score, cut, and coat with chocolate to prevent moisture absorption. There are many precooked dry cereal products which can be used to give body and flavor to these wheyfers.

Whipped-whey fudge (Table 2). Cook the sugar, corn sirup, and invert sirup to 272 F and

allow to cool slowly to 230 F. Whip the sweetened condensed whey in a mechanical beater for at least 5 min. Mix the cooled sirup, whipped whey, and vanilla and carefully fold in the melted chocolate. Avoid excessive stirring of the finished mixture. Pour into wooden forms.

Whey fudge (Table 2). Cook (with stirring) the sweetened condensed whey, sugar, half the corn sirup, and the invert sirup. The cream or butter may be added after the sirup has been partly boiled down. Cook to 248 F. Cool 25 or 30 degrees or transfer to smaller pouring kettles, add the remaining corn sirup, fondant, and chocolate, and stir well for several minutes. Add the powdered lactose, flavoring, and nuts, and stir for several minutes. Pour into wooden forms.

Whey caramel (Table 2). Cook the ingredients to about 246 F. The milk products may be added after the sirup has been partly boiled down. Add nuts and flavoring before pouring on a stone slab.

Whey taffy (Table 2). Cook the sweetened condensed whey and sugar to 248 F, or higher, if desired; cool, add chocolate, and pull.

References

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