Using Dairy Ingredients to Reduce Sodium in Snacks

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WI Center for Dairy Research

DMI Innovation Forum

February 9-10, 2010

DAIRY MANAGEMENT INC.™

NATIONAL DAIRY FOODS RESEARCH CENTERS

Sodium Content of Snacks

(Sources: www2.Kelloggs.com, www.quakeroats.com, www.orville.com, www.spunkmeyer.com, www.pillsbury.com)

Product	Average Sodium Content (mg)
Salted nuts, chips, pretzels (1 oz)	150-300
Microwave popcorn (35 g)	350-390
Crackers (6 crackers)	150-250
Biscuits and muffins (each)	210-250
Cookies (30 g)	100-150
Granola bars/cereal bars (24-36 g)	75-120
Salt (tsp)	2200

Potential Dairy Ingredients

Composition	Deproteinized Whey[1] (DPW) %	Delactosed Permeate (DLP) %
Protein *(non-protein nitrogen)	3.50*	7.32
Carbohydrate	82.00	59.60
Fat	<1.0	0.03
Moisture	4.50	3.00
Ash	8.50	26.97
Sodium	0.83	2.00
Calcium	0.44	3.76
Potassium	2.47	6.29
Magnesium	0.11	0.24

[1]Also referred to as permeate, high lactose whey, or dairy product solids

Wisconsin Center for Dairy Research

DAIRY PIPELINE

A Technical Resource for Dairy Manufacturers Volume 17 Number 1 2005

Composition and production of permeate and delactosed permeate

by Karen E. Smith, Ph.D, Wisconsin Center for Dairy Research

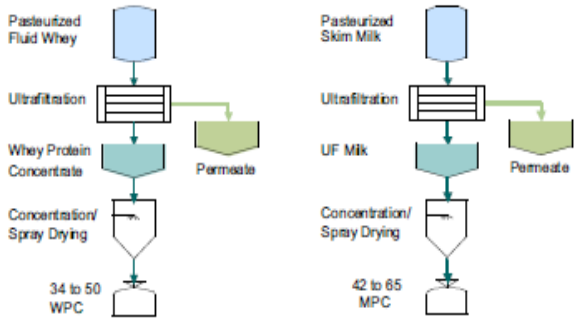
The separation of dairy proteins by ultra-filtration continues to be a growth industry. The whey processing industry is one of the main success stories that has benefited from separation technologies. Filtration processes to concentrate whey proteins have led to the development of very high value, functional and nutritious ingredients that fill a nutritional need in energy bars, sports drinks, and even smoothies. Filtration results in components that are retained by the membranes and those that permeate the membrane. Typically the retained components are the higher value components. The commercial food ingredient permeate is a byproduct of whey protein concentrate (WPC) or ultra filtered (UF) milk production.

Permeate actually is a term used to cover a family of products. They have a minimum of 59% lactose, maximum of 10% protein and maximum of 27% ash. However, the protein value is misleading since little or no protein is present. Manufacturers in the U.S. can use the term "dairy product solids," "de-proteinized whey," "modified whey," "reduced protein whey" or "permeate" when they label this ingredient on a product.

Sweet, acid, casein or rennet whey, or milk, may be used as a starting material. Composition of permeate will vary somewhat, depending on the original material used. In the United States, sweet whey and milk are the most common starting materials for permeate production.

Ultrafiltration is the process that produces permeate (Figure 1). Ultrafiltration membranes retain protein and fat while allowing lactose and minerals to pass. It is the lactose and minerals portion crossing the membrane that is referred to as permeate. The protein fraction, with a portion of the lactose and minerals originally present, becomes WPC or UF milk depending

Figure 1. Production of WPC and UF milk



Wisconsin Center for Dairy Research

DAIRY PIPELINE

A Technical Resource for Dairy Manufacturers Volume 17 Number 4 2005

Whey permeate offers benefits in baked products

By Kathy Nelson, Wisconsin Center for Dairy Research

Whey proteins have risen from obscurity to ordinary, finding a niche in everything from sports drinks to cake mixes. Can whey permeate find the same success?

During ultrafiltration and diafiltration, whey proteins are retained by the membrane, while low molecular weight substances, such as lactose and minerals, pass through and become the permeate stream. Once moisture is removed from the liquid permeate stream, an off-white, free-flowing powder with a mild dairy flavor, remains. Whey permeate, dairy products solids, de-proteinized whey or modified whey, are all names that refer to the collection of substances left after protein, and some lactose and minerals, have been removed from whey. The main constituent of permeate is lactose, and therefore, it is the lactose that dictates the ability of permeate to improve the texture of baked products, affect the appearance and color, extend sweeteners or shortening, and provide a cost-effective source of dairy minerals, such as calcium and phosphorus.

The composition of whey permeate will vary due to milk source, cheese type and processing conditions. Cow's milk is typically used for cheesemaking in the USA, and cheeses are generally cultured cheeses, such as cheddar or mozzarella, leaving liquid whey, known as sweet whey. Other things that can influence permeate composition include the filtration, evaporation, and spray drying conditions used. See Table 1. from USDEC (US Dairy Export Council) showing typical composition of food grade permeate from sweet whey.

Permeate offers benefits

Permeate can offer many benefits in baked products, like enhanced surface browning and flavor development, moisture retention and development of a tender crumb structure. Permeate has a "salty" flavor, and, for this reason, salt can often be reduced or eliminated in a formulation. Permeate does contain approximately 0.6% sodium and will influence the nutritional label. This is a positive influence, though. For example, reviewing the scone formulation, you can see that the NFDM and permeate replacement will have similar levels of sodium. But when you eliminate the salt, you improve the nutritional label because the sodium decreases by half.

Permeate can replace other dairy ingredients, particularly those low in protein (sweet whey, WPC-34 or NFDM), or present in low amounts (2% or under). Using permeate to replace structural components, such as flour or eggs, can be more difficult since permeate lacks protein. Success will vary with the application.

A significant amount (5-8%) of permeate can be used in products like muffins, scones, or cookies, resulting in products of similar or

Table 1.

Component	Sweet Whey Permeate (Powder)(%)
Lactose	65.0-85.0
Protein*	3.0-8.0
Ash	8.0-20.0
Fat	<1.5
Moisture	3.0-5.0
Calcium	0.75-0.90
Phosphorus	0.70-0.75

*Please note that permeate contains only trace amounts of protein. Commercial specifications however, list protein typically around 3.5 to 5%. The discrepancy is due to the dairy industry testing for total nitrogen, a number which is then automatically multiplied by 6.38. The nitrogen found by testing is largely nonprotein nitrogen (NPN), rather than true protein. Examples of NPN compounds found in milk and whey include urea, creatine, creatinine, uric acid, orotic acid, and ammonia.

University of Wisconsin—Extension College of Agricultural and Life Sciences

www.cdr.wisc.edu

Dried Dairy Ingredients

Types of milk, whey and permeate • Dried dairy ingredients • Dairy ingredients from milk • Dairy ingredients from whey

Wisconsin Center for Dairy Research

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This document, prepared by the Wisconsin Center for Dairy Research and funded by Wisconsin Milk Marketing Board and Dairy Management, Inc., is intended to help clarify how milk and whey are converted into dried dairy ingredients. The document includes commonly used dairy terms, manufacturing and processing technology, and applicable technical information. When citing this information as a reference, please credit the Wisconsin Center for Dairy Research, the document name and date of the publication.

May 15, 2008

New Research Related to Taste Perception

- Ohsu et al. Involvement of the calcium-sensing receptor in human taste perception. *Journal of Biological Chemistry* 2010;285(2):1016 DOI
- Compounds that can enhance sweet, salty, and umami taste sensations ─ kokumi compounds
- **Calcium**, protamine (in milk), L-histidine (amino acid), glutathione (in yeast extract) activate calcium-sensing channels
- Many dairy ingredients contain calcium and non-protein nitrogen compounds, which enhance salt perception

Pound Cake

(with no added salt)

Ingredient	(%)
Unsalted butter	26.67
Whole egg	21.25
Cake flour	20.21
Sugar	20.00
Whole milk	5.46
Deproteinized whey	**5.00**
Vanilla	0.87
Baking powder	0.54
Total	100.00

Cookies

(with no added salt)

Ingredient	(%)
All-purpose flour	28.09
Unsalted butter	16.61
Semi-sweet chocolate chips	14.51
Brown sugar	13.11
Granulated sugar	11.36
Whole eggs	9.62
Deproteinized whey	**6.00**
Sodium bicarbonate	0.40
Vanilla	0.30
Total	100.00

Scones

(with no added salt)

Ingredient	(%)
All-purpose flour	50.00
Water	18.97
Unsalted butter	10.34
Whole eggs	9.48
Granulated sugar	6.90
Deproteinized whey	**2.59**
Baking powder	1.72
Total	100.00

CDR Work Reducing Sodium with Deproteinized Whey

Product (Serving Size)	Control Sodium Content (mg)	DPW/No Salt Sodium Content (mg)
Scones (55 g)	230	110
Chocolate chip cookies (30 g)	100	40
Snack cake (55 g)	45	40
Pound cake (88 g)	150	80
Muffins (55 g)	230	85

DAIRY MANAGEMENT INC.™

Asian Dipping Sauce with Deproteinized Whey

Deproteinized whey delivers piquancy, sweetness and functionality to this tangy, Asian-inspired sauce—a perfect complement to grilled meat or vegetables.

Ingredient	Usage Level (%)
Water	40.12
Corn Syrup Solids	15.00
Deproteinized Whey	**10.00**
Sugar	9.80
White Vinegar (5% acetic acid)	8.00
High Fructose Corn Syrup	5.00
Garlic, Minced	4.00
Onion, Chopped	3.00
Stabilizer Blend*	2.80
Salt	1.00
Paprika	0.60
Lactic Acid (88% solution)	0.25
Chilies, Dried, Ground	0.23
Monosodium Glutamate	0.20
TOTAL	100.00 %

* 39710/HAMULSION STAS by GC Hahn

Preparation:

1. Place onion and garlic in a food processor and puree until smooth. Set aside.
2. Weigh the stabilizer blend and mix with part of the sugar until homogeneous.
3. Add water to the stabilizer blend/sugar mixture, stirring until dispersed. Set aside and allow to hydrate for 10-15 minutes.
4. Add stabilizer mixture, garlic/onion puree and all remaining ingredients to the food processor. Process for 30 seconds.
5. Pour mixture into a heating vessel and heat until temperature reaches 185° F (85° C).
6. Cool sauce and cold-fill into containers.

Developed at the Wisconsin Center for Dairy Research, University of Wisconsin-Madison.
 Note: This formula serves as a reference. Product developers are encouraged to modify the formula to meet manufacturing and finished product specification needs.

Market Insights:

- Asian-inspired foods keep gaining in popularity as Americans enjoy more ethnic flavors and diverse cuisines.
- For consumers on the go, Asian marinades and sauces can help turn ready-to-cook meats and vegetables into quick, nourishing meals.

Benefits of Using Dairy Ingredients:

Deproteinized Whey:

- Blends well with many food flavors.
- Allows for reduced sodium content.
- Provides an economical source of dairy solids.
- Contributes body/texture and pleasing mouthfeel.

Nutrition Facts

Serving Size 2 tablespoons (28g)
Servings Per Container

Amount Per Serving	
Calories 45	Calories from Fat 0
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 120mg	5%
Total Carbohydrate 11g	4%
Dietary Fiber 0g	0%
Sugars 6g	
Protein 0g	
Vitamin A 2% •	Vitamin C 0%
Calcium 2% •	Iron 0%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Enjoy this sample, courtesy of Dairy Management Inc.™
Call **1-800-248-8829** for assistance with new formulations and product development.

Other possible applications for reduced-sodium dips/sauces

(120 mg sodium/svg)

www.innovatewithdairy.com

DAIRY MANAGEMENT INC.™

Dulce de Leche with Deproteinized Whey

This caramel sauce gets its rich flavor and creamy texture from dairy ingredients, including deproteinized whey.

Market Insights:

- Dulce de leche has traditional appeal to Hispanics, a segment of the U.S. population projected to reach 64.2 million by the year 2020.
- It is often used as a dessert topping, dip for fruit or bread spread.
- It is also a popular component of ice cream, candy and cakes.

Ingredient	Usage Level (%)
Whole Milk	**39.49**
Sucrose	25.65
Corn Syrup, 42 DE	18.53
Heavy Cream	**7.05**
Nonfat Dry Milk	**4.50**
Deproteinized Whey	**4.50**
Sodium Bicarbonate	0.21
Vanilla	0.07
TOTAL	100.00 %

Preparation:

1. Place milk and cream in a steam-jacketed kettle. Add sodium bicarbonate. The pH of this mixture should be 6.2–6.4 to avoid precipitation of the proteins.
2. Heat mixture to 60°C (140°F).
3. Add nonfat dry milk, deproteinized whey, sugar and corn syrup to milk mixture.
4. Cook to 78% solids (approximately 105°C or 221°F) with constant stirring.
5. Stir in vanilla.
6. Fill containers with hot mixture, cover and cool.

Developed at the Wisconsin Center for Dairy Research, University of Wisconsin-Madison.
 Note: This formula serves as a reference. Product developers are encouraged to modify the formula to meet manufacturing and finished product specification needs.

Benefits of Using Dairy Ingredients:

Whole Milk:

- Complements subtle caramelized sugar flavor.
- Provides emulsion stability.
- Contributes to characteristic texture and mouthfeel.

Heavy Cream:

- Adds body and rich flavor.

Nonfat Dry Milk:

- Contributes to a well-emulsified caramel with uniform incorporation of air.
- Provides added dairy proteins and sugars to develop target texture and mouthfeel.

Deproteinized Whey:

- Helps develop rich, brown color and caramelized flavors.
- Contributes functional sugar from dairy source.
- Provides some saltiness to enhance flavor.

Nutrition Facts

Serving Size (41g)
Servings Per Container

Amount Per Serving	
Calories 100	Calories from Fat 15
	% Daily Value*
Total Fat 1.5g	2%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 5mg	2%
Sodium 70mg	3%
Total Carbohydrate 19g	6%
Dietary Fiber 0g	0%
Sugars 15g	
Protein 2g	
Vitamin A 2% • Vitamin C 0%	
Calcium 6% • Iron 0%	

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	2,500
Total Fat	Less Than	65g	80g
Saturated Fat	Less Than	20g	25g
Cholesterol	Less Than	300mg	300 mg
Sodium	Less Than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Enjoy this sample, courtesy of Dairy Management Inc.™ Call **1-800-248-8829** for assistance with new formulations and product development. For additional sample formulations and the latest on dairy ingredients, visit **www.innovatewithdairy.com.**

Confections
(70 mg sodium/svg)
www.innovatewithdairy.com

Innovation Forum Prototypes

- Apricot almond muffin samples
  - Control muffin with salt – 230 mg
  - Muffin with deproteinized whey and no added salt – 70 mg
  - Muffin with delactose permeate and no added salt – 90 mg

Thank You

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