

# *Dairy Processing: What the Future Might Bring?*



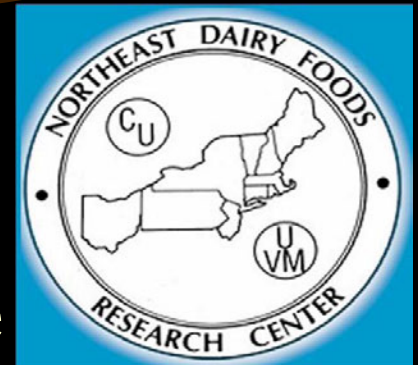
CORNELL

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# *Topics*



- 1. Less sodium, less calories, and more nutrition.**
- 2. The shift towards shelf-stable dairy products.**
- 3. Protein standardization in fluid milks.**
- 4. Protein fractionation for nutritional beverage and food ingredient use (skim milk refining).**

# Less sodium and calories, but more nutrition.



- Current recommendation = 2300 mg/day of sodium
- New recommendation by the Department of Health and Human Services = 1500 mg/day of sodium
- Based on positive correlation between daily sodium intake and hypertension.

# Less sodium and calories, but more nutrition.

## Daily Nutrient Goals (for a 2,100 Calorie Eating Plan)

- Total fat 27% of calories
- Saturated fat 6% of calories
- Protein 18% of calories
- Carbohydrate 55% of calories
- Fiber 30 g
  
- Sodium 2,300 mg\* (recommended to reduce to 1500 mg)
- Potassium 4,700 mg
- Calcium 1,250 mg
- Magnesium 500 mg
- Cholesterol 150 mg

*\* 1,500 mg sodium was a lower goal tested and found to be even better for lowering blood pressure. It was particularly effective for middle-aged and older individuals, African Americans, and those who already had high blood pressure.*

# Less sodium and calories, but more nutrition.



## Where is the sodium in dairy?

### Low-fat or fat-free milk and milk products

- Milk, 1 cup 107 mg
- Yogurt, 1 cup 175 mg

### Cheeses

- Natural cheeses, 1.5 oz 110 to 450 mg
- Process cheeses, 2 oz 600 mg

# Less sodium and calories, but more nutrition.



- **Sodium**

- Sodium free or salt free

Less than 5 mg per serving

- Very low sodium serving

35 mg or less of sodium per

- Low sodium serving

140 mg or less of sodium per

- Reduced or less sodium

At least 25 percent less sodium than the regular version

- Light in sodium

50 percent less sodium than the regular version

- Unsalted or no salt added

no salt added during processing

# Less sodium and calories, but more nutrition.



- **Fat**

- Fat-free                      Less than 0.5 g per serving
- Low saturated fat            1 g or less per serving and 15% or less of calories from saturated fat
  
- Low-fat                        3 g or less per serving
  
- Reduced fat                 At least 25 percent less fat than the regular version
  
- Light in fat                 Half the fat compared to the regular version

# The shift towards shelf-stable dairy products.



- Shelf stable milk has a big market outside the US, but shelf-stable fluid milk has never been popular in the US.
- However, there is a lot of shelf-stable milk solids milk solids being sold in aseptic and retorted “non-dairy” beverages (coffee blends, sports recovery beverages, meal replacements, protein waters).

# The shift towards shelf-stable dairy products.



## Ingredients

**BREWED ESPRESSO COFFEE (WATER, COFFEE), REDUCED FAT MILK, SUGAR, CREAM, NONFAT MILK, CARAMEL COLOR, ASCORBIC ACID**

# Protein standardization of fluid milks.

- Definition of Standardized Milk

The lacteal secretion, practically free from colostrum, obtained by the complete milking of one or more healthy cows. Milk that is in the final package form for beverage use shall have been pasteurized or ultrapasteurized, and shall not contain less than 8.25% solids not fat and not less than 3.25% of milk fat.


**Milk may have been adjusted by separating part of the milkfat therefrom, or by adding thereto cream, concentrated milk, dry whole milk, skim milk, or nonfat dry milk. Milk may be homogenized.**

# **Protein standardization of fluid milks.**



- **How much of the value of milk that is paid to the farmer is for protein and how much is for fat?**
- **On average the value of the protein portion of milk is higher than the fat or the fluid portion of milk.**

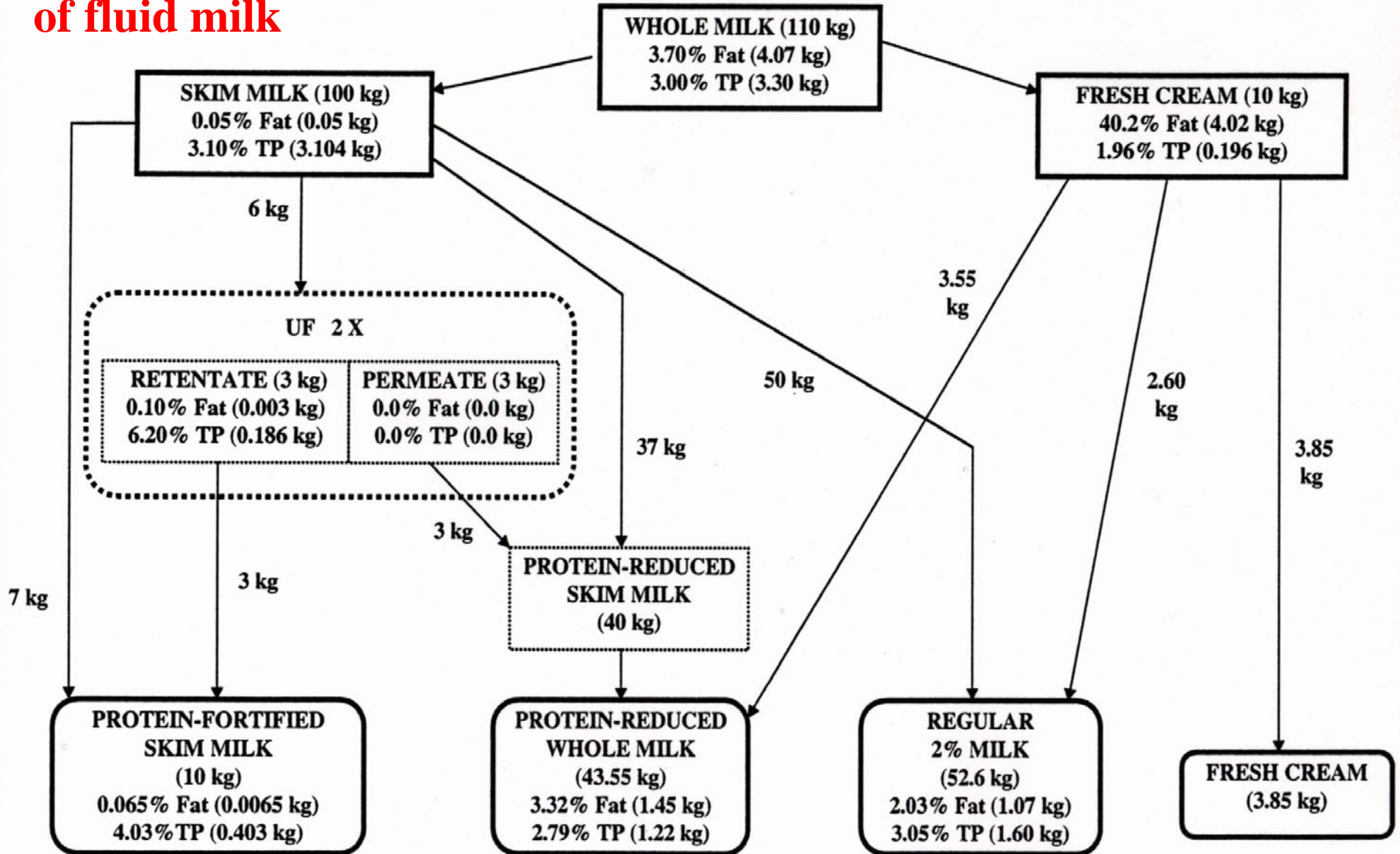
# *What is the Value of Fat and Protein in Milk For the Farmer?*



Announced Class 3*	% of \$ Butterfat	% of \$ Protein
Average	43%	52%
Min	35%	39%
max	53%	66%

\* Average for the period January 2009 through March 2011

# Protein Standardization of fluid milk



# Protein fractionation for nutritional beverage and food ingredient use.



**Milk Refining** – the first step in this was taken more than 100 years ago with the development of the mechanical cream separator. This allowed almost complete removal of the fat portion of milk.

**Where are we?**

**What is this place?**

Tomorrow Land



# *Milk Refining Developments*



**Milk Refining** – the first step in milk refining was taken more than 100 years ago with the development of the mechanical cream separator. This allowed almost complete removal of the fat portion from milk.

# *Milk Refining: The Beginning in the 1890's*



# *Milk Refining Developments*



## **Membrane Separation Technologies**

In the 1960 and 70's **reverse osmosis** and **ultrafiltration** technologies began to be applied in the dairy industry.

**Ultrafiltration** has been used to separate proteins from lactose and soluble minerals.

# *Milk Refining Developments*

## **Membrane Separation Technologies**

**More recently, nanofiltration has been used to separate soluble minerals and microfiltration has been used to separate casein from milk serum (whey) proteins.**

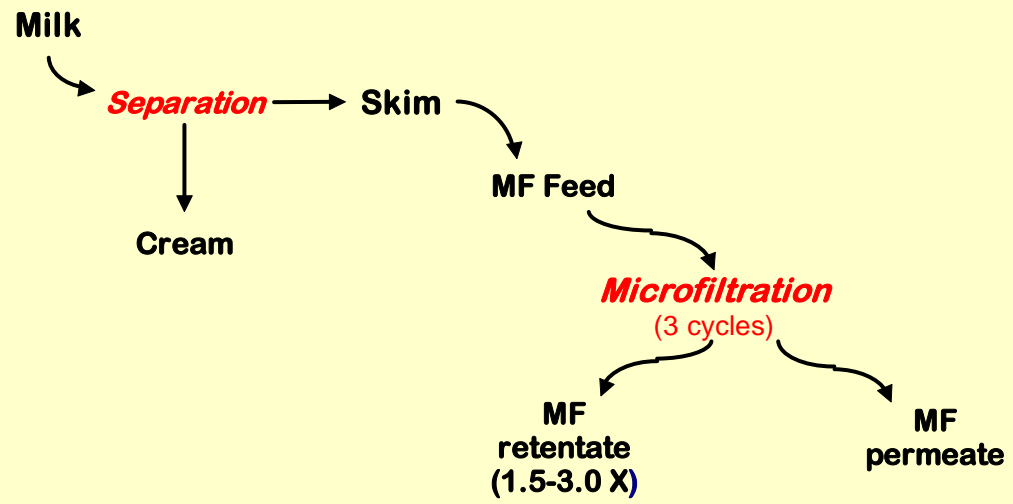
**These technologies will have a lasting impact and role in the dairy industry, as we have seen for cream separation.**

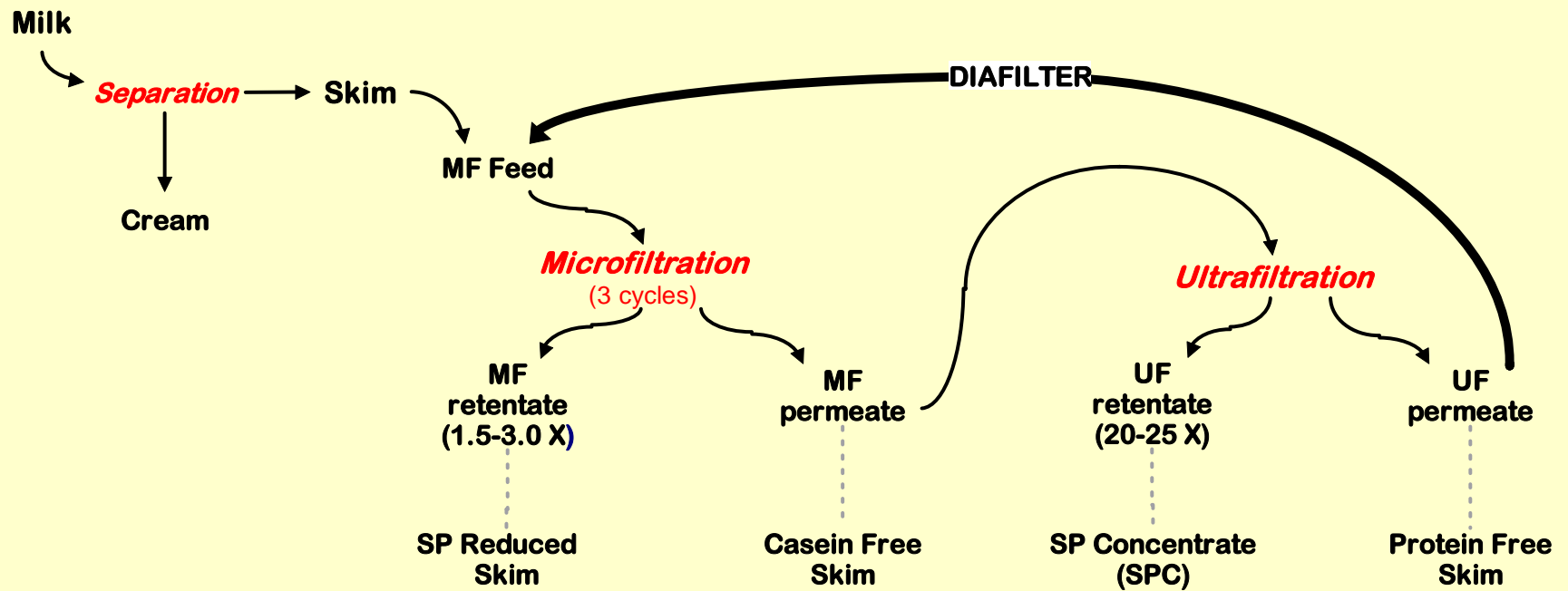


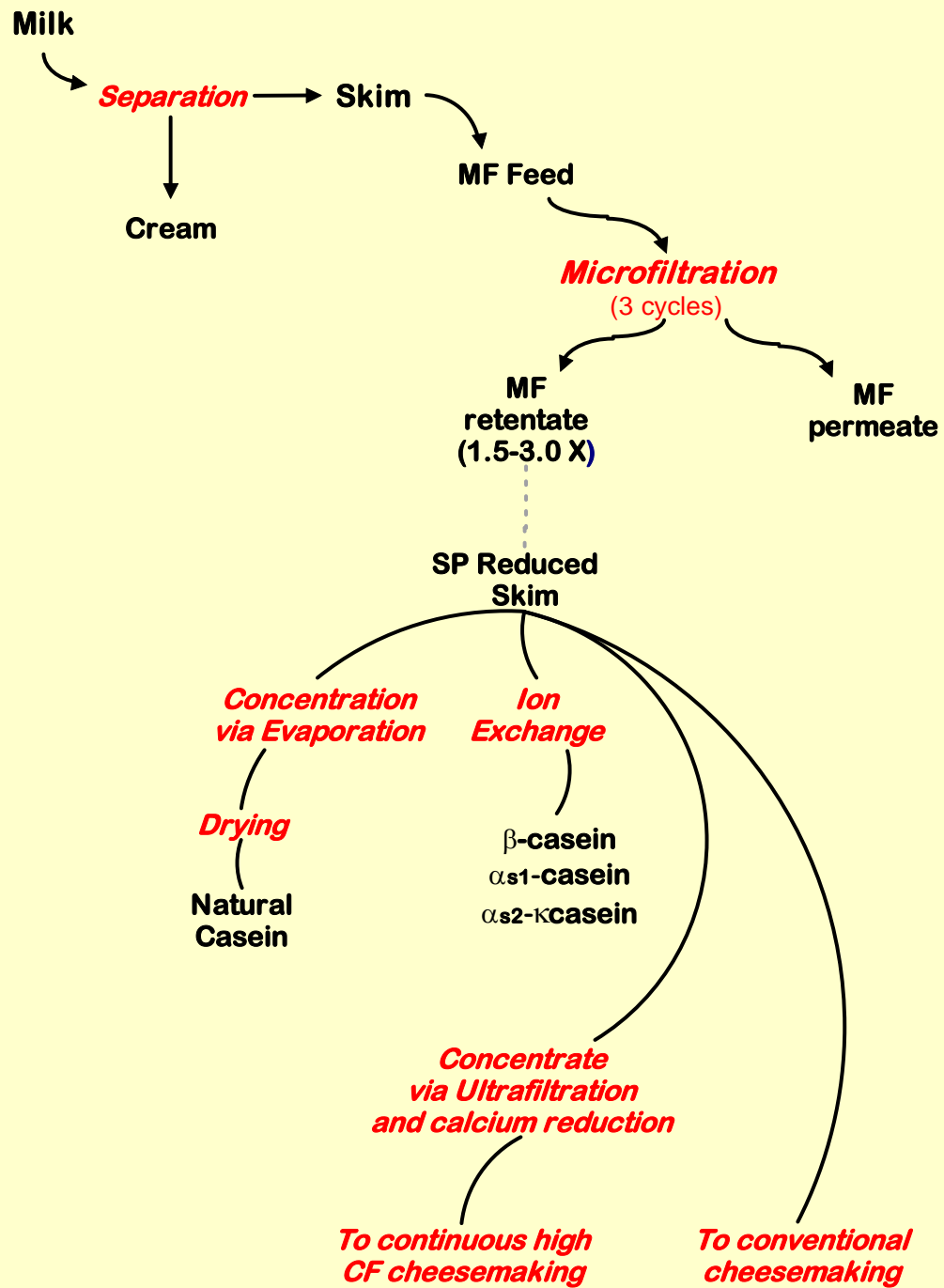
# *Milk Refining Developments*

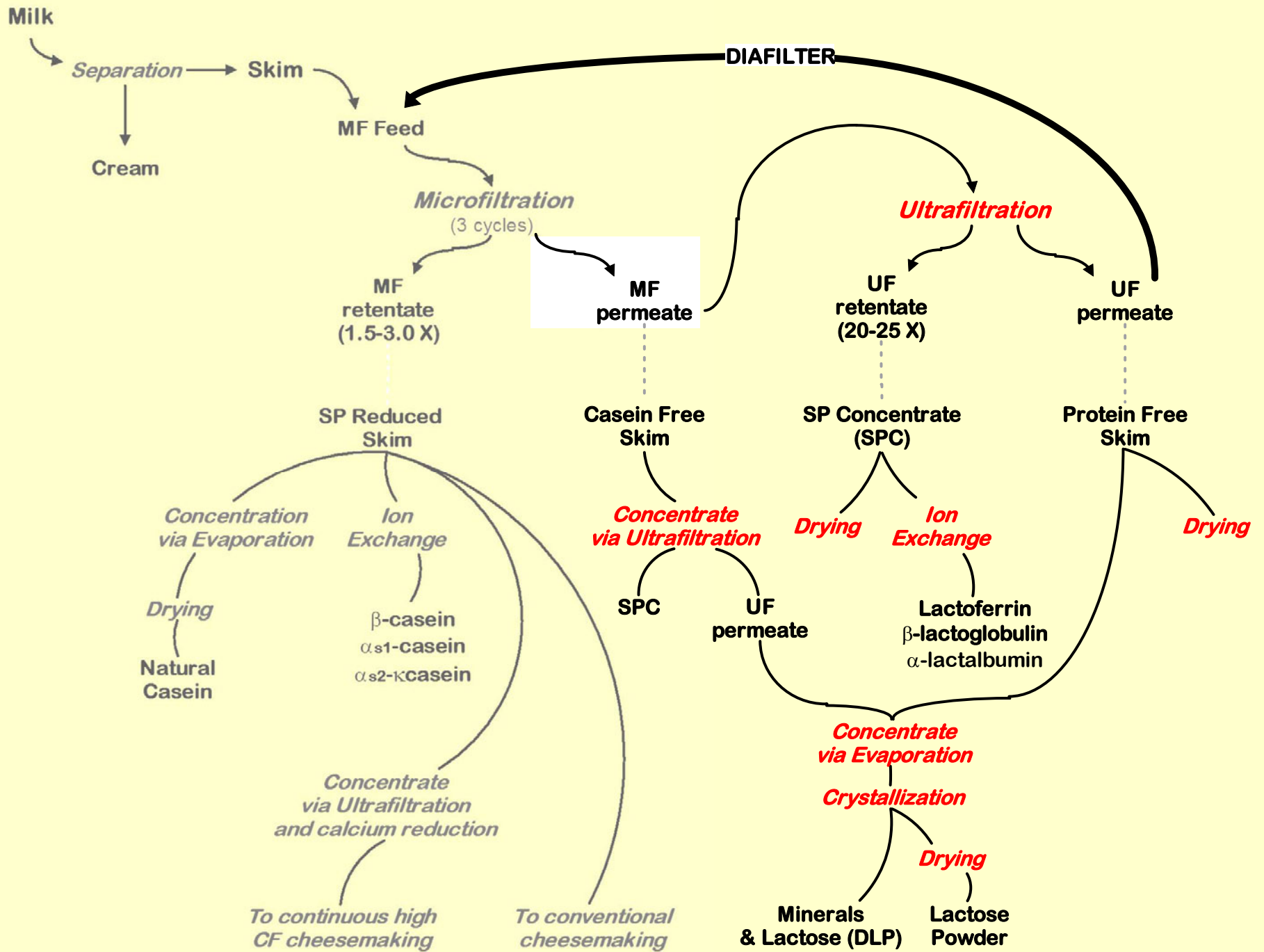
## **Membrane Separation Technologies**

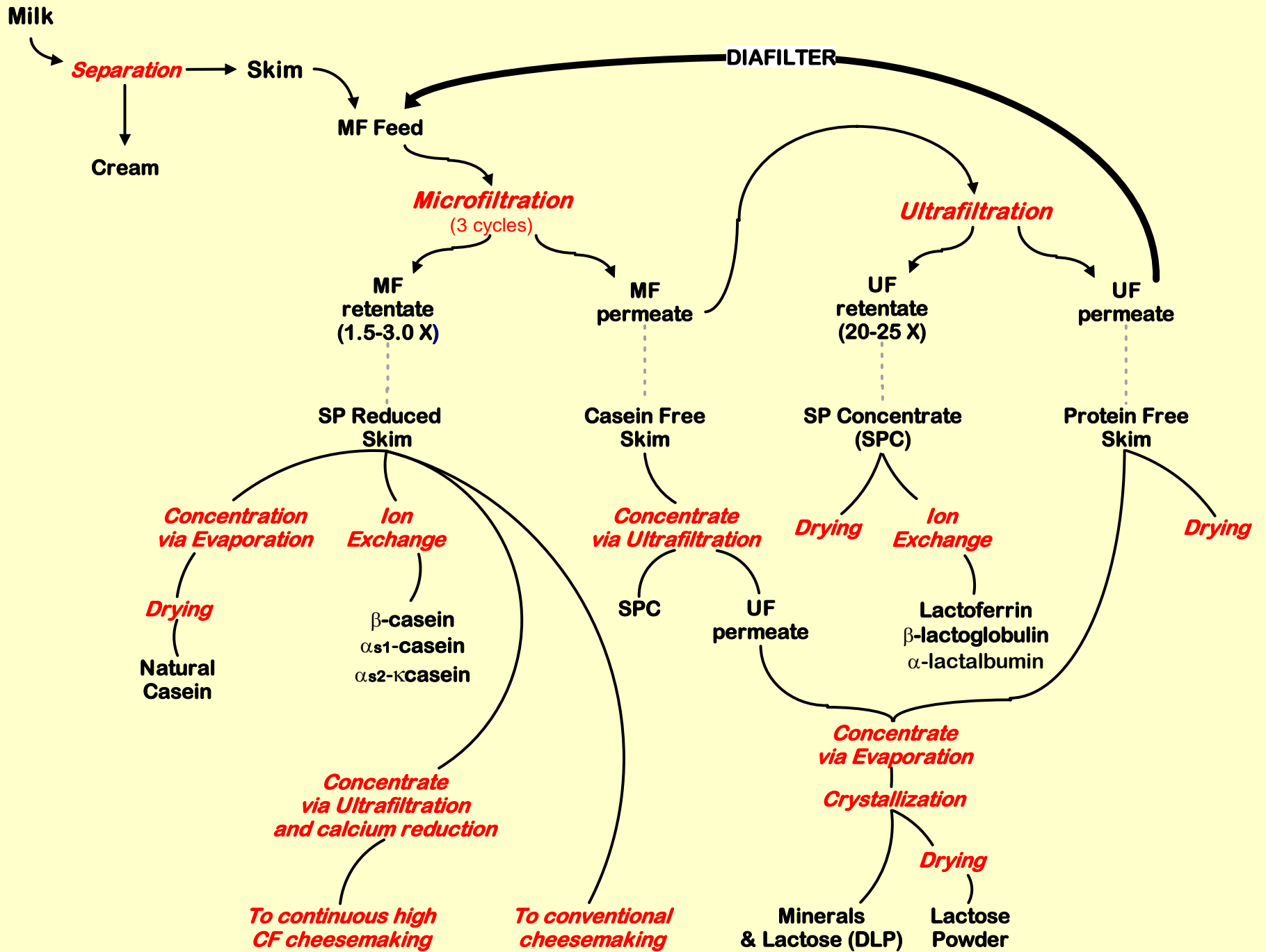












# *Milk Refining Developments*



**Ion Exchange** technologies have been used to process fractions of proteins from membrane filtration and further separate and isolate individual milk proteins.

A commercial example is lactoferrin isolation from whey.

# *Milk Refining Developments*



## **Ion Exchange**

**In the future, the individual proteins, both macro and micro constituents in milk will be separated for use as functional ingredients in food and nonfood systems.**

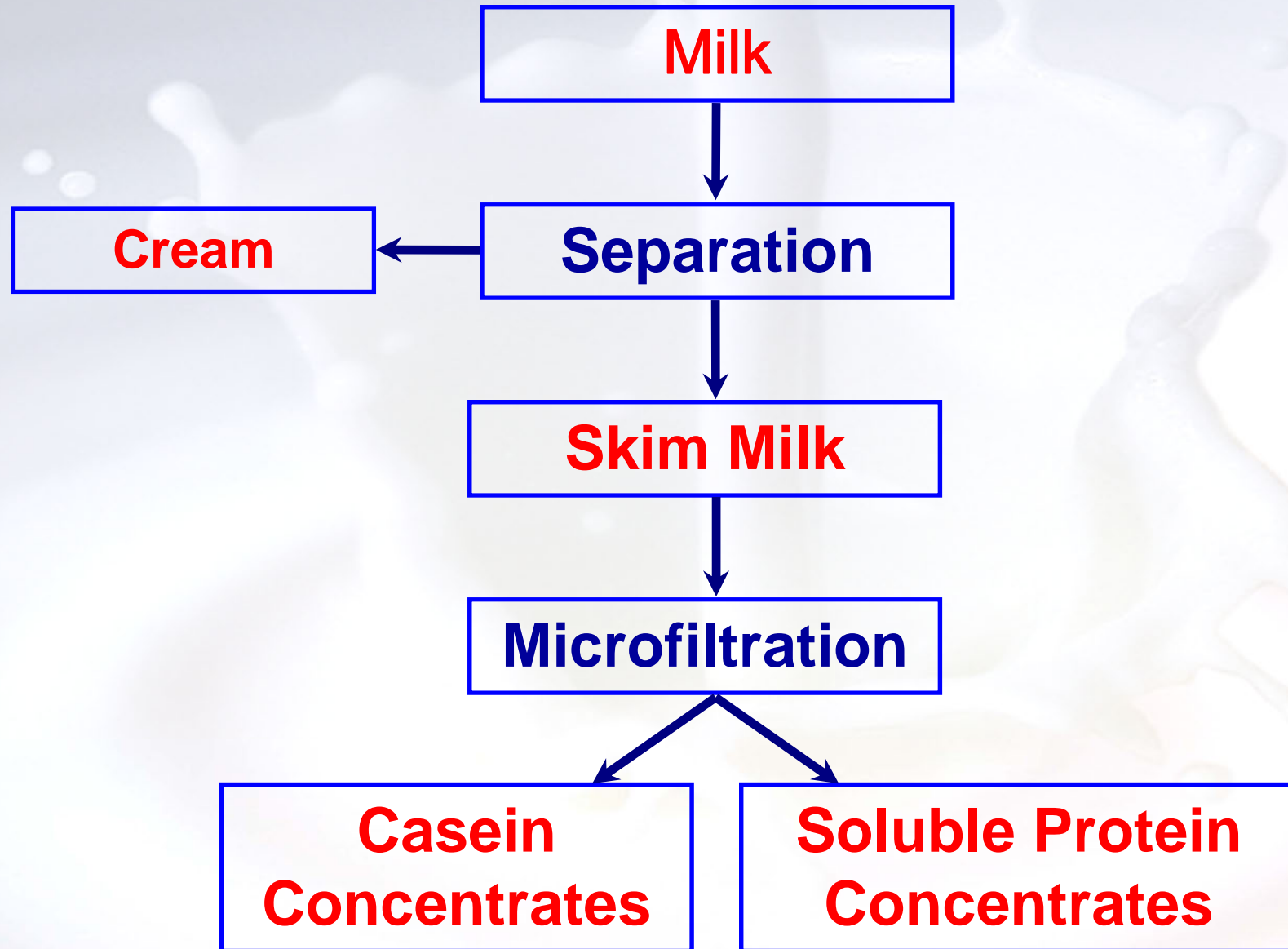
**This can be applied to both the serum protein and casein fraction of milk.**

# *Milk Protein Ingredient Applications*

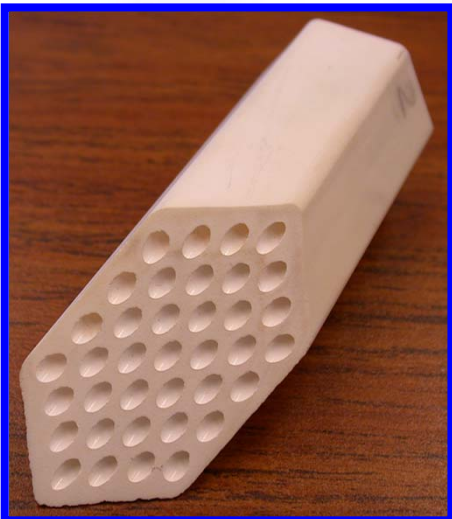


The non-dairy beverage category represents a huge opportunity for value added growth for both milk producers and processors.

# MILK PROTEIN FRACTIONATION



# Microfiltration unit



**Skim Milk**

**Casein Concentrate**



**MICROFILTRATION**

**Soluble Protein Concentrate**



## **Casein Concentrate**

- Protein Fortified Juices
- Protein Fortified Sports Beverages
- Protein Fortified Water

### **Application**

- Adult Nutritional Beverages
- Protein and Calcium Fortified Milk
- Shelf Stable Energy Drinks
- Nutritional Beverage for Diabetics
- Cheese Manufacture

## **Serum Protein Concentrate**

**There is a need to integrate a healthy, well-balanced products for improving strength and increasing endurance**

**Milk Soluble Proteins have a very high nutritional quality**

**Facts**

**They are an excellent source of essential amino acids**

**W.H.O. recommends that a 150 lb person consume a minimum of 31 grams of protein per day**

## *Total Non Dairy Beverage Consumption*

*Segments*

*Milions of Gallons in 2007*

<b>Carbonated Soft Drinks</b>	<b>14,707.4</b>
<b>Bottled Water</b>	<b>8,822.4</b>
<b>Fruit Beverages</b>	<b>3,899.5</b>
<b>Sport Drinks</b>	<b>1,355.1</b>
<b>RTD Tea</b>	<b>875.1</b>
<b>Energy Drinks</b>	<b>302.6</b>

Source: BEVERAGE MARKETING CORPORATION

**DESIRE for  
PROTEINS**

**What if we added  
5 grams of milk soluble  
proteins per serving to 3% of  
the total non-milk beverages?**

<i>Segments</i>	<i>Milions of gallons of protein fortified beverages</i>	<i>Millions of pounds of milk soluble proteins needed</i>
<b>Carbonated Soft Drinks</b>	<b>441.2</b>	<b>76.6</b>
<b>Bottled Water</b>	<b>264.7</b>	<b>45.9</b>
<b>Fruit Beverages</b>	<b>117.0</b>	<b>20.3</b>
<b>Sport Drinks</b>	<b>40.7</b>	<b>7.1</b>
<b>RTD Tea</b>	<b>26.3</b>	<b>4.6</b>
<b>Energy Drinks</b>	<b>9.1</b>	<b>1.6</b>
<b>TOTAL</b>	<b>898.9</b>	<b>156.0</b>

**3% of each  
beverage type**

**5 grams of milk soluble  
proteins per serving**

**156 million pounds of  
milk soluble proteins NEEDED**

If we **FORTIFY** only  
3% of annual non  
dairy beverage  
production with  
milk soluble  
proteins

If we **ADD** only  
5g of milk  
soluble proteins  
per serving

IF

THEN

We can  
**INCREASE**  
milk protein  
consumption by  
156 million pounds

We can  
**INCREASE**  
milk protein  
consumption in  
beverages by 9%

# *Developing the Concept of Milk Refining*

## **Conclusions**

**We have a lot of the technical details and experience with various pieces of a milk refinery system. However, the optimal way to integrate these pieces in the context of the structure of the US dairy industry and the customers served by the dairy industry remains to be achieved.**

*What is the next move?*



# *Development of Milk Refining*



**The Dairy Centers, DMI, the Cornell University Department of Food Science and Cornell Program on Dairy Markets and Policy are ready to work with the industry to obtain answers to important questions and partner with the industry in development of the Milk Refinery approach.**