

# **New Consumer Dairy Products From Membrane Technology<sup>1</sup>**

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New dairy products are very important because they have the potential to expand the total consumer demand for milk. For this reason the Southwest Dairy Farmers of Sulphur Springs, Texas sponsored research to assess the potential of membrane filtration technology. When it comes to new products, membrane technology has had tremendous success creating new products from whey. Could similar results be achieved relative to changes in fluid, soft, and frozen dairy products?

Figure 1 shows how various membrane filtration processes work. At the far left of this figure, only small molecules are able to pass through the membrane. Reverse Osmosis (RO) is a tight filtration process which will keep almost all milk component molecules except water from passing through the membrane. Moving to the right in the figure, molecules become larger. Progressively looser membranes such as nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) are used to separate milk components such as lactose, whey solids, casein, butterfat, and even bacteria.

In this article we will only examining new products created by UF. Figure 2 shows how

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<sup>1</sup> The authors wish to express their thanks for support received from the Southwest Dairy Farmers of Sulphur Spings, Texas.

UF can fractionate skim milk into both skim milk retentate and lactose permeate. The creation of skim milk retentate makes possible the manufacture of new dairy products such as:

- *Protein Fortified Fluid Milk* which can be made by a combination of whole milk, skim milk, and skim milk retentate (figure 3).
- *High Protein – Low Lactose Ice Cream* which can be made by a combination of sweet cream, skim milk retentate, and non-fat dry milk (figure 4).
- *High Protein – Nonfat Yogurt* which can be made with skim milk, skim milk retentate, and nonfat dry milk. This process uses less stabilizers than normally needed to make nonfat yogurt (figure 5).

### **Economics**

To begin, it was necessary to estimate manufacturing costs for each of these new dairy products. Figure 6 presents this information for each product. When compared to a regular dairy product, the added cost to make high protein fluid milk equaled \$0.16/gallon. For high protein - lower lactose ice cream this added cost equaled \$0.41/gallon mix. (One gallon of this mix makes six 1/2 gallons of ice cream). For high protein - nonfat yogurt this added cost equaled \$0.19/gallon. (One gallon of this mix makes 17 eight ounce cups of yogurt).

### **Survey of Milk, Ice Cream, and Yogurt Manufacturers**

Armed with this information, survey instruments were developed and sent to dairy manufacturers of beverage milk, ice cream, and yogurt. Figure 7 presents the results of

the survey. A total of 179 firms were contacted of which 80 firms completed the survey for a total response rate of 45%. Note that participating firms were surveyed for only a single product.

Amongst the firms completing the survey, forty-four percent were in the large size category, having a daily processing volume of over 60,000 gallons. At the other extreme, twelve percent of the firms completing the survey had a daily processing volume under 6,000 gallons. Twenty-six percent of participating firms did not manufacture for private labels. At the other extreme, twenty-two percent of participating firms had more than two-third's of total manufacturing volume accounted for by private labels. When the individual completing the survey was asked how often they heard from the final consumer, the majority said less than ten times per month. However, six percent of respondents heard from consumers more than 100 times per month.

### **Survey Findings**

Our survey covered 33 fluid milk bottlers. When we asked if consumers would be willing to purchase *high protein – lowfat fluid milk*, only 21% of these bottlers said yes. When these bottlers were asked if they could recommend one thing to insure that this new product would succeed, 38% named no price premium, 27% said superior taste/mouthfeel, and 24% said advertising. Participating bottlers were relatively large with over 39% of them processing an average daily milk volume in excess of 60,000 gallons for all processing purposes. None of the fluid bottlers surveyed were currently working with membrane technology in the manufacture of dairy products.

Our survey covered 25 ice cream manufacturers. When we asked if consumers would be willing to purchase *high protein, low lactose ice cream*, 32% of these manufacturers said yes. When these manufacturers were asked if they could recommend one thing to insure that this new product would succeed, 76% named superior taste/mouthfeel, 20% named advertising, and only 8% named no price premium. Participating ice cream manufacturers were not quite as large as the milk bottlers. However, 28% of these manufacturers did receive an average daily milk volume in excess of 60,000 gallons for all processing purposes. Sixteen percent of these ice cream manufacturers were currently using membrane technology for dairy purposes.

Our survey covered 22 yogurt manufacturers. When we asked if consumers would be willing to purchase *high protein, nonfat yogurt*, 45% of these manufacturers said yes. When these manufacturers were asked if they could recommend one thing to insure that this new product would succeed, 68% named superior taste/mouthfeel, 31% named no price premium, and only 5% named advertising. Participating yogurt manufacturers were very large with 68% reporting an average daily milk volume in excess of 60,000 gallons for all processing purposes. Eighteen percent of these yogurt manufacturers were currently using membrane technology for dairy purposes.

### **Implications**

It is evident that most firms are not eager to accept these new products ideas. However, there are some specific individual firms that are interested. Consequently it seems likely

that if one of these products (most likely the yogurt) were to gain widespread consumer distribution, it would be because one particular firm spearheaded the marketing effort. Comments made by particular survey respondents are shown in figure 8.

Membrane technology, in combination with more traditional technologies, creates the ability to custom tailor the percentage content of all milk components. Regarding protein, FDA has no minimum protein test standard for milk. Consequently, membrane technology has the potential to be used, in the name of efficiency, as a technology to reduce the protein content of dairy products. Such a practice would hurt both dairy farmer income and also deprive consumers of the expected nutritional benefits they expect from dairy products. Thus it is important for dairy farmers to emphasize the positive nutritional attributes of their products. Furthermore, it is important for dairy farmers to take steps to maintain and enhance the standards of identity for their products.

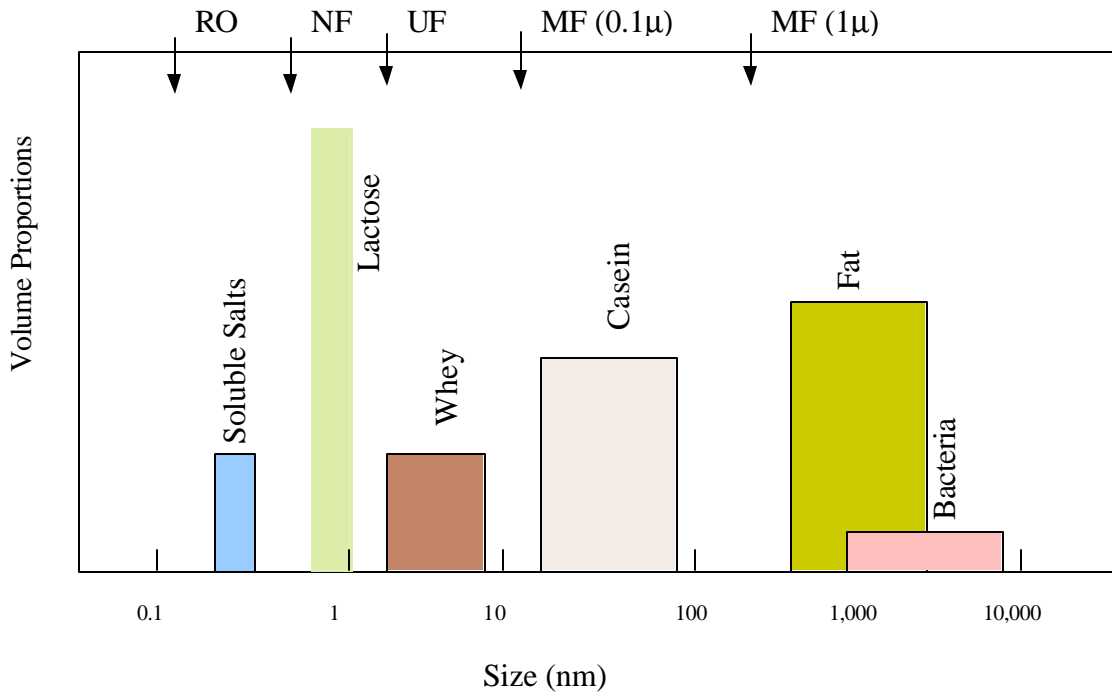
## **References**

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Siebert, John W. and Alejandro Lalor. *New Consumer Dairy Products From Membrane Technology*. Texas A&M University. September 15, 1999. 48pp.

Figure 1. Milk component distribution by size and its relationship to the membrane process



nm: Nano-meters = 0.000000001m or  $10^{-9}$  m  
 μ: Micro-meters = 0.000001m or  $10^{-6}$  m  
 m: meter

Figure 2. Manufacturing Skim Milk Retentate – the Building Block for New Dairy Products in This Study.

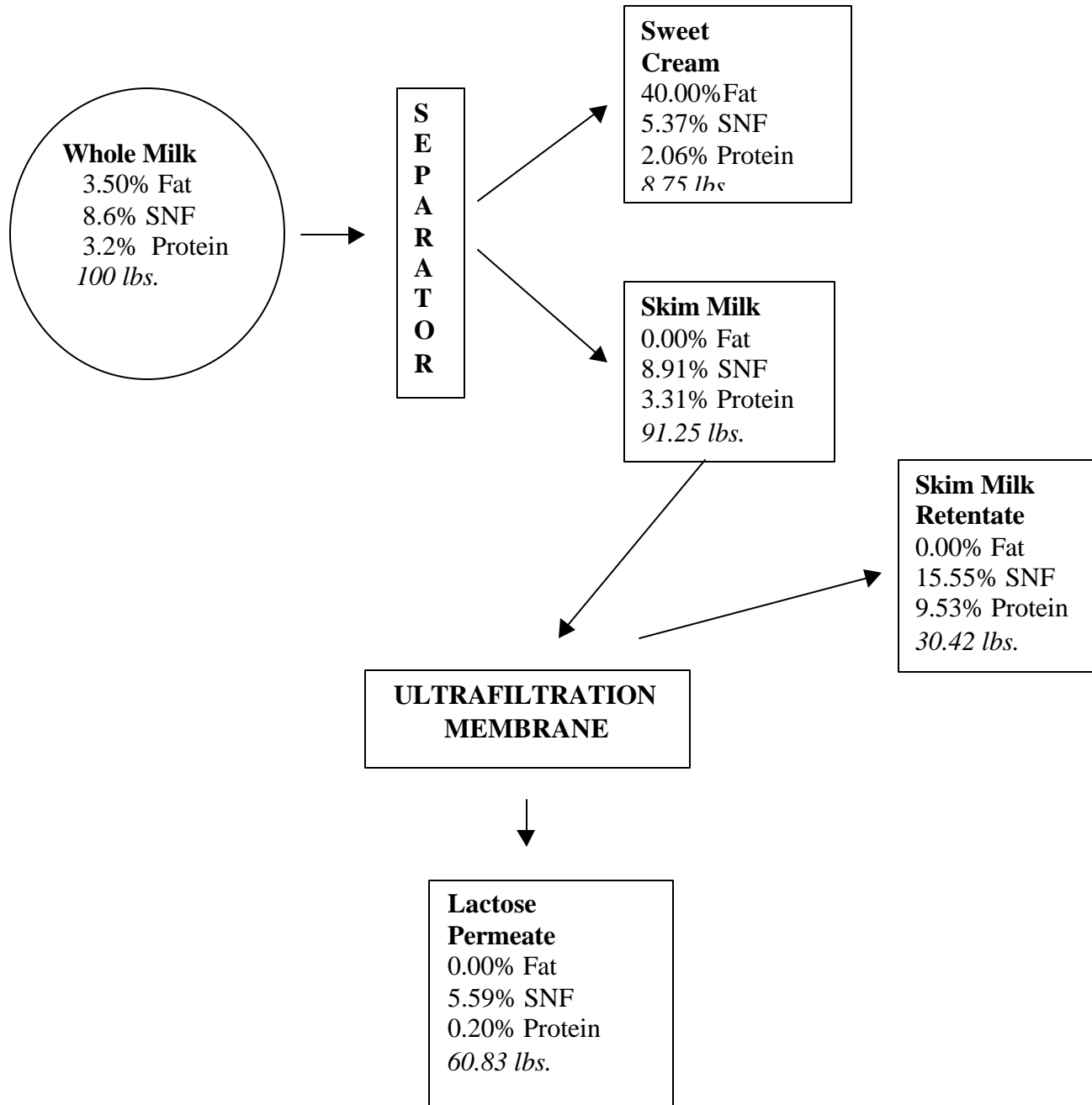


Figure 3. New Product Idea: Manufacture of Protein Fortified Fluid Milk

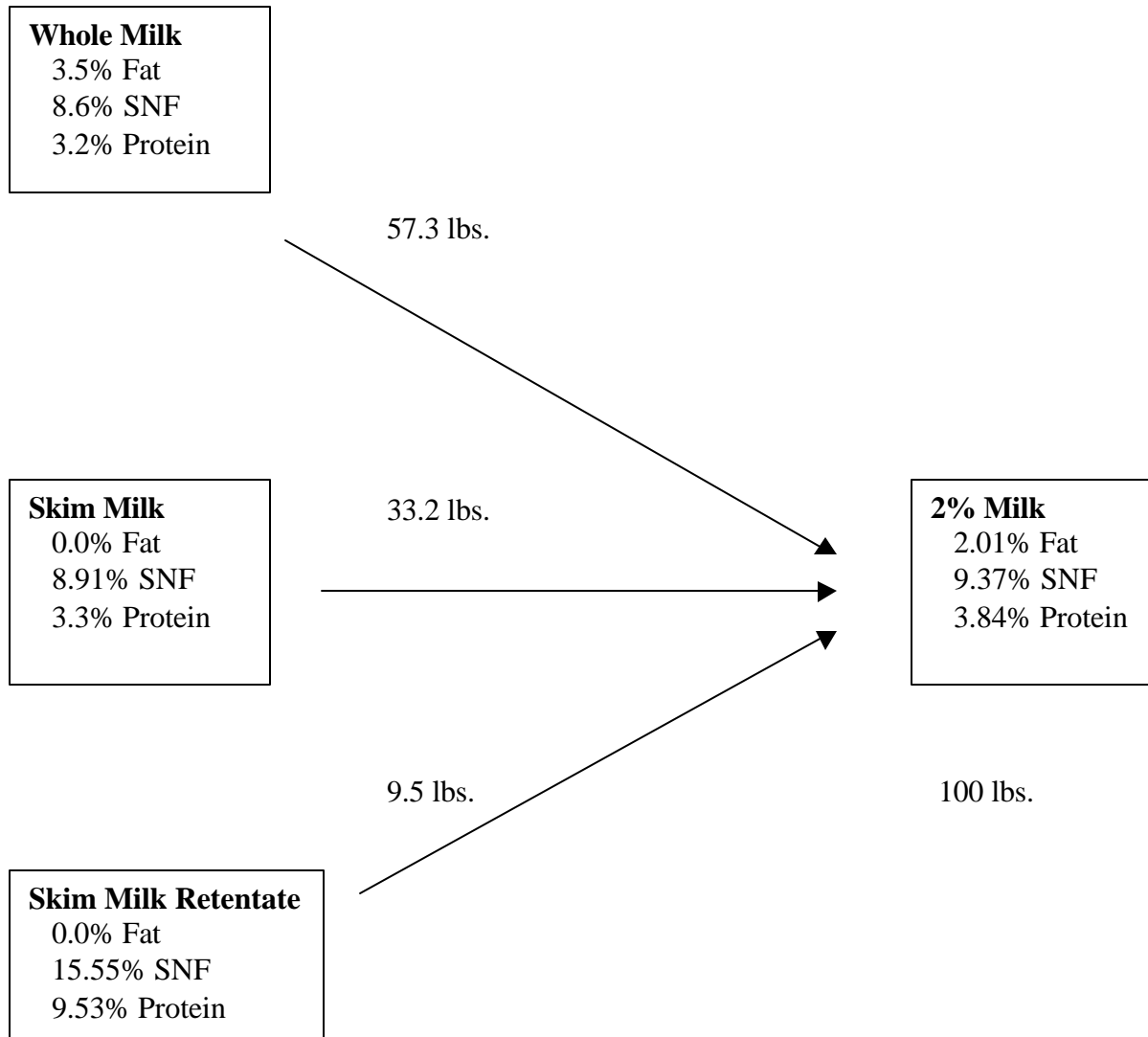


Figure 4. New Product Idea: Manufacture of High Protein, Low Lactose Ice Cream

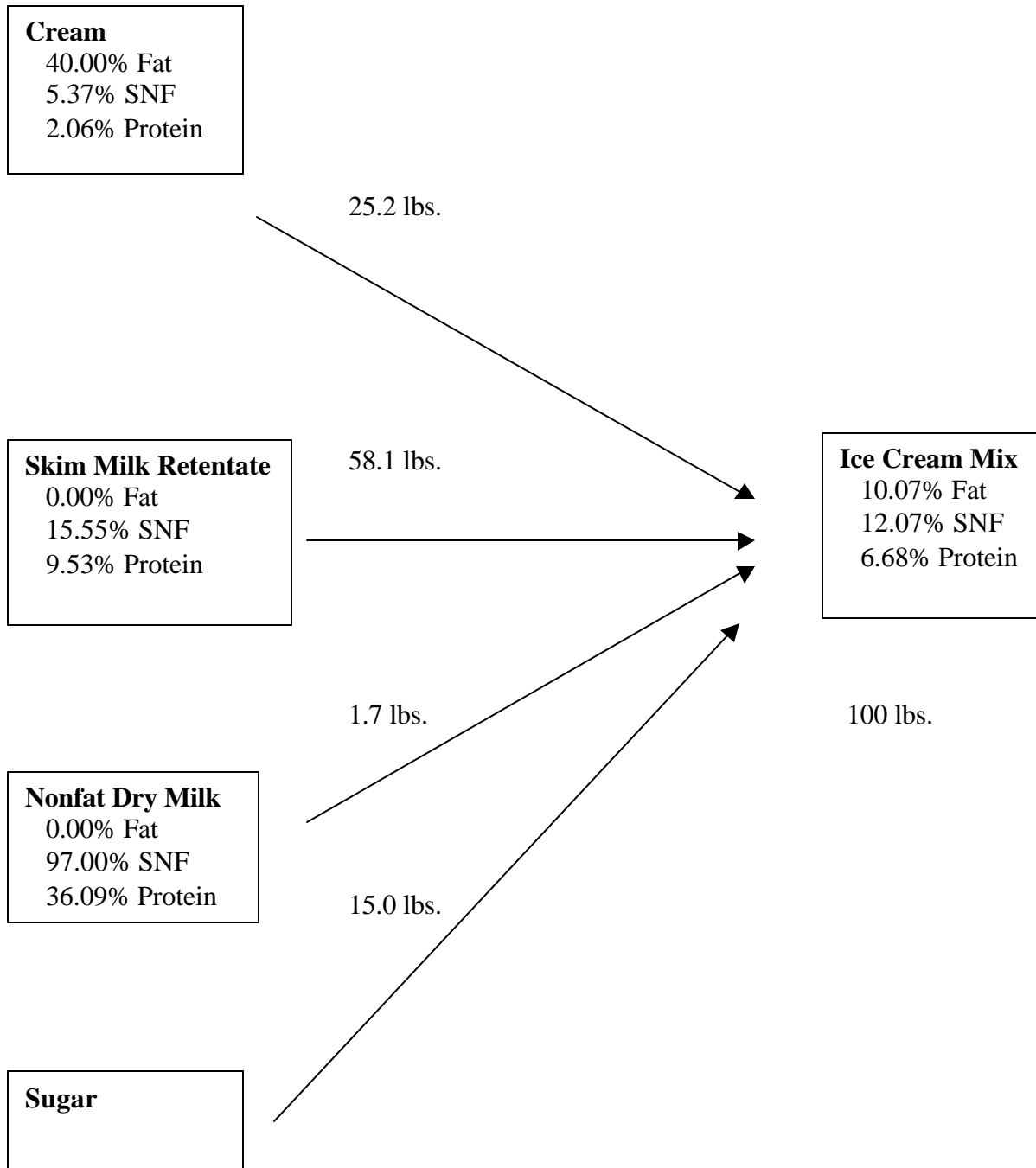


Figure 5. New Product Idea: Manufacture of High Protein, Non-fat Yogurt

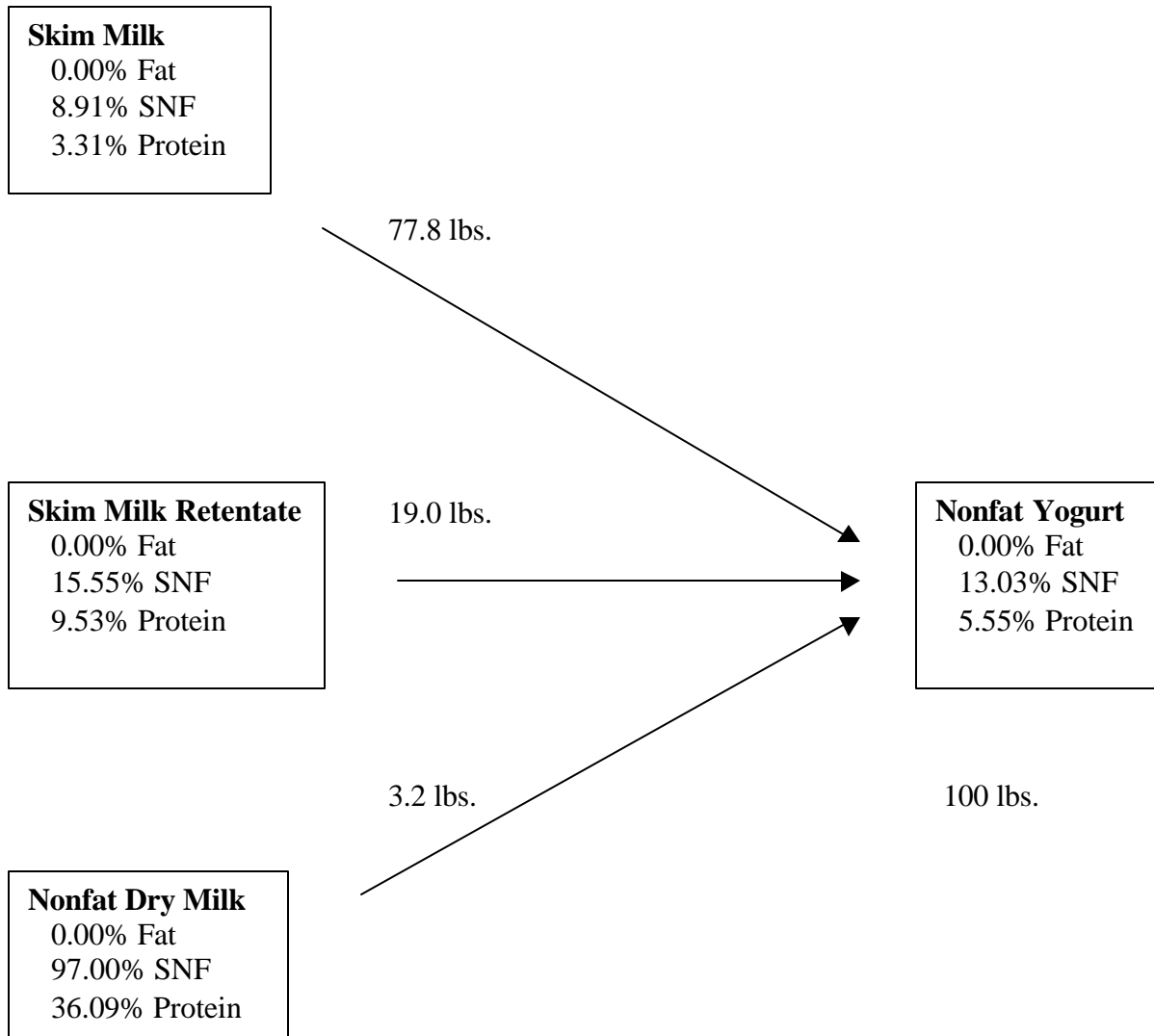


Figure 6. Increased Costs to Manufacture New Dairy Products

End Product:	High Protein, 2% Butterfat Fluid Milk	High Protein, Lower Lactose Ice Cream Mix	High Protein, Non-fat Yogurt Mix
End Product Output per Day (a)	375,000 lbs. milk	200,000 lbs. mix	100,000 lbs. mix
System Capital Cost	\$455,000.00	\$1,240,000.00	\$455,000.00
10 Yr. Depreciation (b) (312 day basis)	\$145.83/day	\$397.44/day	\$145.83/day
Operating Cost (c)	\$675.00/day	\$2,025.00/day	\$675.00/day
Daily Capital & Operating Cost (b + c)	\$820.83/day	\$2,422.44/day	\$820.83/day
Capital & Operating Cost per Cwt. Finished Product a / (b + c)	\$0.22/cwt.	\$1.21/cwt.	\$0.82/cwt.
Added Milk Component Cost	\$1.62/cwt.	\$3.59/cwt.	\$1.40/cwt.
Total Added Cost	\$1.84/cwt. (or \$0.16/gal.)	\$4.80/cwt. (or \$0.41/gal. Mix)	\$2.22/cwt. (\$0.19/gal. Mix)
Comparison to Estimated Prevailing Retail Price	\$2.50/gal.	One gallon of mix will make four ½ gallons of ice cream selling for \$3.00 per ½ gal.	One gallon of mix will make 17-8oz. cups of yogurt selling for \$0.50 per cup.
Raw Product Cost Increase as a % of Prevailing Retail Price	6.4%	3.4%	2.2%

Figure 7. Summary of Results From New Product Surveys of Fluid Bottlers, Ice Cream Makers and Yogurt Makers

<b>Survey Question</b>	<b>Response</b>
Number surveys sent out	179
Number of surveys returned	80
Response rate	45%
Number of firms responding:	
Fluid milk processors	33
Ice cream manufacturers	25
Yogurt manufacturers	22
Total firms	80
Daily processing volume of responding firms:	
Under 6,000 gallons	12%
6,000 to 30,000 gallons	20%
30,000 to 60,000 gallons	24%
Over 60,000 gallons	44%
All firms	100%
Firms' sales accounted for by private label:	
None	26%
Less than 1/3	24%
1/3 to 2/3	28%
Over 2/3	22%
All firms	100%
How often the person completing the questionnaire heard from consumers:	
Less than ten calls per year	11%
Less than ten calls per month	44%
10 to 100 calls per month	39%
Over 100 calls per month	6%
All firms	100%
Percent of firms using membrane technology for dairy purposes:	10%

Figure 8. Some Comments of Survey Respondents

Comment:	Source:
<p>“Our current business is price driven, thus the supplier would have to absorb any price increase.”</p>	<p>- - <i>a bottler in the State of Washington</i></p>
<p>“We make a NFDM fortified product. At standard retail price it sells well. However, with a \$0.05/gal. premium, it does not sell well.”</p>	<p>- - <i>a bottler in the State of New York</i></p>
<p>“I am not sure customers would understand or care.”</p>	<p>- - <i>an ice cream maker in Wisconsin</i></p>
<p>“This would take advertising.”</p>	<p>- - <i>an ice cream maker in the high plains</i></p>
<p>“Shelf placement is critical.”</p>	<p>- - <i>a yogurt maker in Illinois</i></p>
<p>“Superior flavor and texture at a competitive price will be a new product requirement.”</p>	<p>- - <i>a yogurt maker in Ohio</i></p>