Protein Standardized Powders: Another Jersey Advantage

Exports of U.S dairy products have grown impressively since 2003 when less than 6% of domestic milk solids production was exported. In just ten years, exports grew to 15.5% of milk solids. March 2014 set a new monthly high with 17.7% milk solids exports, which represents just over one-sixth of total production. Put in the terms of day-to-day dairy operations, for herds milking twice per day, one milking every three days is exported, while herds milking three times per day export one milking every other day.

The growth in exports is particularly good news for Jersey producers. After all, what gets exported are milk solids in the form of cheese, milk powders, whey products and butterfat, and Jerseys excel at the efficient production of milk solids. Two products leading the export surge are skim milk powder (SMP) and whole milk powder (WMP). Production of SMP (protein standardized nonfat dry milk) nearly tripled from 2009 to 2013, while WMP production grew over 20% in the same time period *(Table 1)*. International buyers prefer SMP and WMP due to their predictability of use which results from being protein standardized. Because both powders are protein standardized, beginning the manufacturing process with high component milk offers significant economic advantages.

Table 1: Production of Milk Powders (1,000 pounds)

Year	Nonfat Dry Milk	Skim Milk	Whole Milk
2011	1,514,410	446,017	65,787
2012	1,764,450	380,672	58,132
2013	1,477,860	630,689	72,053

While attending IDFA's Dairy Forum in late January, National All-Jersey staff inquired of an industry associate about the imminent opening of their new powder production facility. The response came that it was still a few weeks off, and the manager lamented that the plant wasn't already in production. "If we were making whole milk powder and selling it on the GDT (Global Dairy Trade), we'd be printing money," he said.

NAJ staff replied, "And if the whole milk powder was being made from Jersey milk, you would be printing even more money."

"Why is that?" came the response. NAJ laid out the following concepts that differentiate Jersey milk from average milk in manufacturing protein standardized powders:

1. Higher protein milk will produce higher protein powder.
2. For export, SMP and WMP can utilize either lactose or permeate to achieve the standardized protein level.
3. Higher protein powder allows processors to utilize more lactose or permeate in the standardization process.
4. In 2013, lactose could be purchased for an average of $0.66 per pound, while SMP sold for an average of $1.72 per pound and WMP sold for an average of $1.87. Buying lactose and permeate and selling it as SMP and WMP made for a very profitable transaction.

"Those all make sense. Can you quantify how much the economic advantage is using Jersey milk?"

Thus was born the following project. National All-Jersey Inc. compiled an economic analysis of nonfat dry milk (NDM), SMP and WMP production, comparing Jersey milk to average milk. The analysis incorporated different component levels in producer milk, along with 2013 average prices for the products of cream, butter, anhydrous milk fat (AMF), NDM, SMP, WMP and the input costs of Class IV nonfat solids and butterfat, along with lactose and permeate.

Nonfat Dry Milk (NDM)

Long the staple milk powder product, nonfat dry milk (NDM) has been produced forever and a day by separating fat (usually in the form of cream) from skim, and drying the skim milk to powder consisting of the nonfat solids. Simple milk chemistry stipulates that higher protein milk yields higher protein powder. More protein in the raw milk leads to more protein in the skim, resulting in a higher protein powder. Table 2 shows that typical Jersey milk will yield powder approximately 40% crude protein, nearly 3.5% higher than powder produced from average milk. However, as a non-standardized product, higher protein NDM does not command a greater market price than average protein NDM, thus the economic advantage to making NDM from high protein producer milk is limited.

Table 2: Milk Components (%)

	Average Milk	Jersey Milk
Butterfat	3.74	4.79
True Protein	3.10	3.64
Other Solids	5.70	5.75
Nonfat Dry Milk		
Crude Protein	35.96	39.24

Skim Milk Powder (SMP)

The international standard for SMP calls for it to contain 34% crude protein. NDM containing more than 34% crude protein can be converted to SMP by extending it with lactose or permeate until the powder reaches the 34% level. The amount of protein in the skim portion of the milk to be dried determines the volume of SMP that can be produced. As is shown in Table 3, because of its higher protein content, NDM made from 100 pounds of Jersey milk can utilize nearly an additional pound of lactose or permeate in the process of making SMP than can NDM made from 100 pounds of average milk. Jersey milk will yield 1.4 more pounds of SMP per hundredweight (cwt.) than average milk. At 2013 prices, the added yield was worth an additional $2.41/cwt. of producer milk.

Table 3: *Product Yields (lbs./cwt.)*

	Average Milk	Jersey Milk	Jersey Advantage
Cream (45% butterfat)	8.21	10.55	2.34
Nonfat Dry Milk	8.72	9.17	0.45
Skim Milk Powder	9.54	10.94	1.40
Added lactose	0.79	1.72	0.93
Whole Milk Powder	13.12	15.19	2.07
Added lacose	0.39	1.27	0.88
Andydrous Milkfat	3.70	4.75	1.05
Nonfat Dry Milk	9.15	9.76	0.61
Skim Milk Powder	10.01	11.65	1.64
Added lactose	0.83	1.83	1.00
Whole Milk Powder	13.16	15.32	2.16
Added lacose	0.40	1.32	0.92

Whole Milk Powder (WMP)

Manufacturing WMP is more complex than NDM or SMP due to the need to standardize butterfat, protein and, by definition, the ratio of butterfat to protein. Another important consideration associated with WMP is that because it contains butterfat, it needs to be kept refrigerated to prevent the butterfat from going rancid. Neither NDM nor SMP require refrigeration. While the standard of identity

for whole milk powder requires the product to contain between 26% and 40% butterfat, the accepted standard for international trade is 26.8%.

As with NDM, the process begins by separating the cream. Virtually all producer milk has more butterfat than is needed for the WMP in relation to its amount of protein. Therefore, the next step is to calculate how much cream to add back (or conversely, not to add back) to the skim before the drying process. After the powder is produced, the next step is to determine how much lactose or permeate can be added to standardize the powder to protein specifications. As with SMP *(Table 3)*, nearly an extra pound of extender can be utilized in the standardization process for powder made from Jersey milk. Given Jersey milk's higher levels of butterfat and protein, its yield of WMP per hundredweight is 15.19 pounds, over two pounds greater than from average milk. The added yield resulted in WMP product value nearly $4.00 per hundredweight higher than average milk.

Cream vs. Anhydrous Milk Fat (AMF)

The process of making any of the three powders begins with separating cream from skim. Higher-fat content Jersey milk results in greater cream yield. Based on this example, Jersey milk will produce 2 1/3 more pounds of 45% butterfat cream. However, the extra cream is both an advantage and a disadvantage in the production of powder. The portion of cream that is not butterfat is skim, and the skim portion of cream contains nonfat solids. Jersey milk's higher protein content leads to cream that is higher in protein. Protein captured in the cream is not available to produce powder, and protein is more valuable in powder than in cream. Jersey milk will have over two-tenths of a pound of protein in its cream, nearly 50% more protein than average milk.

An alternative use of excess butterfat is anhydrous milk fat (AMF), a shelf-stable butter used for products like cream cheese, processed cheese, popcorn butter and ice cream. Also known as butter oil, AMF requires 99.8% butterfat content. Producing anhydrous milk fat allows more protein to be included in the resulting powder and a yield increase of 0.7 pounds of SMP from Jersey milk.

Both cream and AMF are priced at multiples of the butter market. The industry has a vibrant cream market. When cream is long in the marketplace, the multiple is low. When cream is short, the multiple is higher.

Lactose vs. Permeate

Lactose and milk permeate can be used in the protein standardization process when making skim milk powder and whole milk powder. Milk permeate is a byproduct of the ultrafiltration of milk, and whey permeate is a byproduct of the ultrafiltration of whey. Whey permeate is not allowable as a standardization agent in SMP and WMP. Due to requiring less processing, milk permeate is typically less expensive than lactose. However, of all the input variables used in this analysis, the price of permeate will be the least standard. In addition, some SMP and WMP buyers will specify that permeate cannot be used, requiring the use of lactose. Given that Jersey powders can utilize more extender, when permeate can be used it increases the economic advantage of using Jersey milk.

Value of Product Sold vs. Cost of Inputs

Having calculated the difference in product yields from two types of milk, the final step of the analysis is to compare the costs and returns. For producer milk pooled in the Federal Milk Marketing Orders, any nonfat solids used to make NDM, SMP or WMP is classified and priced as Class IV nonfat solids. The butterfat sold as bulk cream can be priced as Class II, III or IV depending on its ultimate use. Butterfat the plant uses in butter, anhydrous milk fat or as part of WMP is classified and priced as Class IV butterfat.

For the purposes of this analysis, all producer butterfat was priced at Class IV. Therefore, the FMMO regulated minimum cost of producer milk to the processors does not change regardless of which combination of powders and butterfat-based products are manufactured. Logically, Jersey milk costs processors more than average milk given its greater content of nonfat solids and butterfat. Based on 2013 FMMO prices, Class IV Jersey milk cost $2.64/cwt. more than average milk

(continued to page xx)

Anhydrous Milkfat

Anhydrous milkfat (AMF) is the purified form of butterfat consisting primarily of the triglycerides of milkfat. The end product is 99.8% fat. AMF production starts by separating cream from skim. The cream (typically 40% fat) is heated and further separated to a fat content around 73%. The high-fat cream is run through a high-pressure pump which breaks open the milkfat globules, releasing the triglycerides. Then the triglycerides are separated from the mixture to make anhydrous milkfat.

AMF is marketed both domestically and internationally. In the U.S. anhydrous milkfat is primarily used in dairy product recombining, products including cream cheese, processed cheese, milkshake mixes, ice cream, dairy desserts, popcorn butter and confectionaries.

Last year the top five export buyers of U.S. AMF were Europe, the former Soviet Union, Mexico, the Far East and the Middle East.

Table 4: Costs and Returns/Cwt. Producer Milk

	Average Milk	Jersey Milk	Jersey Advantage
Revenue			
Cream & NDM	$21.73	$24.44	$2.71
Cream & SMP	$23.13	$27.47	$4.34
Cream & WMP	$24.97	$29.70	$4.73
Costs			
Cream & NDM	$19.63	$22.27	$2.64
Cream & SMP	$20.15	$23.41	$3.26
Cream & WMP	$19.88	$23.11	$3.23
Net			
Cream & NDM	$2.11	$2.17	$0.06
Cream & SMP	$3.04	$4.14	$1.10
Cream & WMP	$5.08	$6.59	$1.51
Revenue			
AMF & NDM	$23.54	$26.84	$3.30
AMF & SMP	$25.01	$30.06	$5.05
AMF & WMP	$25.10	$30.15	$5.05
Costs			
AMF & NDM	$19.63	$22.27	$2.64
AMF & SMP	$20.18	$23.48	$3.30
AMF & WMP	$19.89	$23.14	$3.25
Net			
AMF & NDM	$3.92	$4.57	$0.65
AMF & SMP	$4.83	$6.58	$1.75
AMF & WMP	$5.20	$7.01	$1.81

(Table 4). The cost of lactose or permeate must also be included when analyzing returns for SMP and WMP. Because Jersey milk can use more lactose and permeate in the standardization process, their cost is greater for Jersey milk-based powders. However, the additional value from the added powder yields more than offset the costs of the standardizing component.

The returns from the powder and butterfat-based products are also greater from using Jersey milk. The magnitude of the higher values depends on the product mix. In this analysis the combination of NDM and bulk cream sales only provides a net advantage to Jersey milk of $0.06/cwt. However, when the product mix is changed to SMP and cream, the Jersey advantage jumps to $1.10/cwt. Even better returns can be realized from the combination of WMP and cream ($1.51/cwt.).

If a processor can utilize the excess butterfat as anhydrous milk fat instead of cream, the returns increase further. AMF siphons off none of the nonfat solids from the skim portion of the milk, leaving more nonfat solids available for powder production. The product combination of SMP and AMF showed Jersey milk with a $1.75/cwt. advantage, while WMP and AMF resulted in $1.81/cwt. net return advantage.

The above examples assume that lactose is used in the standardization process. If lower cost permeate can be substituted, the net advantage to Jersey milk increases by $0.20 to $0.30/cwt.

Milk prices posted record highs in 2013, so the analysis was rerun using 2010 prices when the all-milk price was $3.79/cwt. less than 2013. The profit margins for all combinations of products were lower using 2010 prices. The magnitude of the advantage from using Jersey milk also decreased from $0.10/cwt. to $0.40/cwt., depending on the product mix. However, Jersey milk remained the more profitable choice even during that year of low milk prices.

Finally, the returns calculated in this analysis do not include plant costs of making the products. Because Jersey milk has less water to be removed, the drying costs associated with making any powder may be less. Furthermore each processing plant utilizes different technology and processes in manufacturing milk powders and butterfat-based products. Therefore, this analysis should be viewed as illustrative of the profit advantages of using higher protein milk instead of a benchmark against which to measure plant performance.

Importance to the US Dairy Industry and Jersey Producers

The Jersey milk advantage when making the milk powders in demand by world buyers is important to Jersey farmers for two reasons. First, if Jersey producers belong to a co-op that manufactures SMP or WMP, producers should query their co-op as to whether high component milk is being directed to powder production in order to maximize the profitability of the plants. Second, if Jersey producers have milk going to plants producing SMP or WMP, producers should be earning premiums for their milk because of the additional yields and profitability provided by Jersey milk.

The economic advantage provided by high component milk is also important to the U.S. dairy industry as it competes for world markets. Because Jersey milk provides greater profitability when used to make skim milk powder and whole milk powder, U.S. manufacturers can remain competitive in world markets at price levels which would be unprofitable if using average milk.

The spreadsheet with the complete NAJ analysis is available at www.USJersey.com/NationalAllJerseyInc/milkpowders.xls.

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