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STATEMENT OF C. K. VENKATACHALAM
LEPRINO FOODS COMPANY
at the
UNITED STATES DEPARTMENT OF AGRICULTURE PUBLIC HEARING ON CLASS III AND IV MILK PRICING FORMULAS

Alexandria, Virginia
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Introduction & Background:

My name is C.K. Venkatachalam and, since it is too long, I have shortened it as Venkat. I am the Director of Whey Products Technical Services for Leprino Foods Company (Leprino), headquartered in Denver, Colorado. My business address is 1830 West 38th Avenue, Denver, Colorado 80211-2200. I hold a Bachelors degree in Chemical Engineering and have 38 years of industrial experience. Early in my career, I worked with multinational companies such as Exxon, Unilever and Cadburys. My past 21 years work has been with the dairy industry and I have been with Leprino Foods for the past 6 years. My background includes designing, installing and commissioning preheaters, evaporators, HTST equipment and flash coolers for milk, whey, whey protein concentrate and permeate products while working with GEA Wiegand, a design engineering firm specializing in dairy evaporation equipment. I worked with GEA for 15 years, and during that time, I was responsible for planning, project engineering, design, installations and startup of 50+ evaporator systems. I have also performed cost / benefit analysis for evaporation / reverse osmosis systems and helped several customers optimize their equipment purchases. In my current position with Leprino, I am responsible for analyzing whey operations with a view to improving efficiencies while maintaining or improving the finished product quality. I also specify major pieces of equipment such as separators/clarifiers, membrane systems, HTST units, evaporators, dryers, powder handling and powder packaging systems and commission them to process the intended products.

Purpose:

The purpose of my presentation today is to provide technical information regarding the differences in the manufacturing processes between whey powder and NFDM, focusing primarily on energy utilization and equipment requirements. Sue Taylor is testifying on behalf of Leprino on the policy issues under consideration at this hearing. One issue that I understand Sue will discuss in her testimony is the need for a higher whey make allowance in the Class III price formula. I am told that when establishing the current Class III price formula, USDA assumed that manufacturing costs for whey and nonfat dry milk (NFDM) are the same. For the reasons discussed below, this is an erroneous assumption.

There are a few similarities between whey powder and NFDM. Before elaborating on the differences, I wish to point out the similarities. Milk for both of these products is processed first through clarifiers for fines removal, separators for skimming fat to an acceptable level and is legally pasteurized in an HTST system. The similarities stop here.

There are significant differences between whey and NFDM. Let me start with the process itself. In addition to the processes required in the production of NFDM, whey powder production requires additional separation and pasteurization, a crystallization process, and a two stage dryer. In addition to the initial pass through a clarifier, separators, and pasteurizer that occurs prior to cheese production, the whey stream coming off the cheese vats must pass through a clarifier and be separated and pasteurized a second time. To produce sweet whey powder, the pasteurized whey is then evaporated to about 52 to 55% solids and is flash cooled to about 85° to 95°F to form nuclei of fine lactose crystals. This product is then cooled in jacketed / agitated crystallizers to about 45°F, under controlled cooling conditions. The resulting slurry is then spray dried in a two stage dryer to produce a free flowing non-caking powder. The powder is packed in poly lined Kraft paper bags which are heat sealed.

There are significant differences between Whey and NFDM with respect to initial solids content. Dilute whey has a total solids content of 6.3% (ranges from 6.1 to 6.5%). For 100 pounds of whey powder we need to remove about 1,440 lbs of water. Expressed another way, we need to remove 14.4 lbs of water per pound of whey powder. About 94% of this water is removed during evaporation while the balance of 6% is removed during drying. As you can see, evaporation is the single most energy intensive operation in the powder manufacturing process.

Skim used to produce NFDM has a total solids content of 9.25% (ranges from 9.0 to 9.5%). Pasteurized nonfat milk is evaporated to about 54% total solids and is spray dried in a hot condition. Unlike whey, there is no crystallization involved. This condensed product is spray dried in a single stage dryer to produce nonfat dry milk and is packed in heat sealed poly lined Kraft paper bags. For 100 pounds of NFDM, we need to remove 1,048 lbs of water. Expressed similar to whey powder, we need to remove 10.5 lbs of water per pound of NFDM.

Thus, the main differences between whey powder and NFDM production can be summarized as follows:

	Whey Powder	NFDM
a) Pounds of water removed per pound of powder	14.4	10.5
b) Energy to crystallize	needed	not needed
c) Capital for equipment	extra clarifier, separator, pasteurizer, larger evaporator, crystallizers and refrigeration equipment, double stage dryer	smaller evaporator, single stage dryer
d) Extra power to operate additional equipment	needed	not needed

As a result of these differences, it costs more to produce whey powder. Although it obviously requires more labor and management to operate and maintain the additional equipment and processes associated with whey production, I will focus on the energy and equipment costs which are within my area of expertise.

Energy costs to produce whey powder are higher than the energy costs to produce NFDM.
associated with producing whey powder and nonfat dry milk:

- dilute whey and skim contain average TS of 6.3% and 9.25% respectively
- assuming no losses, product yields at ~~9%~~ 3% moisture would be 6.49 pounds whey and 9.54 pounds NFDM per 100 pounds of dilute feed
- steam cost of $4.25 per 1000 lbs
- electricity cost of 6¢ per KWH
- 8 lbs of water removal per pound of steam
- Additional power consumption for whey:
  - 4 x 50 HP = 200 HP for separators and clarifiers
  - 6 x 15 HP = 90 HP for crystallizers
  - 10 x 15 HP = 150 HP for additional pumps
  - Total installed = 440 HP. Operate at 75% capacity (330HP). Consumption at 75% capacity will be 247 KWH

My written testimony includes a table that details the calculations.

	Dilute Whey	per pound finished product (6.49# / cwt dilute whey)	Skim	per pound finished product (9.54 # / cwt skim)
Composition (pounds)				
solids	6.30		9.25	
water	93.70		90.75	
total volume	100.00		100.00	
Evaporation to 54% TS				
water removed	88.330		82.870	
÷ # water removed / # steam	8.000		8.000	
pounds steam required	11.000		10.400	
x $ per 1,000 pounds steam	$4.250		4.250	
Steam Cost	$0.047	0.723¢	0.044	0.462¢
Crystallization				
KWH for refrigeration	0.2		none	
price / KWH	$0.060			
Refrigeration cost	$0.012	0.185¢	$0.000	0.000¢

	Dilute Whey	per pound finished product (6.49# / cwt dilute whey)	Skim	per pound finished product (9.54 # / cwt skim)
Drying to 97% TS water removed BTUs required x $ per therm Dryer gas cost	 5.17 11,000 $0.280 $0.031	 0.474¢	 7.59 15,340 $0.280 $0.043	 0.450¢
Additional Power Required (2MM pound / day plant) Additional HP installed HP used (@ 75%) KWH / HP KWH price / KWH Additional power cost / hour 4,875 pounds produced/hour	 440 330 0.748 247 $0.060 $14.82 	 0.304¢		 0.000¢
Total		1.686¢		0.912¢

The calculations of the additional energy cost to produce finished whey relative to NFDM in the above table can be summarized as follows:

	Cents per Pound
Evaporator steam	0.261
Refrigeration for crystallizers	0.185
Dryer gas	0.024
Additional power	0.304
TOTAL	0.774

There are also additional equipment costs associated with producing equivalent volumes of dry whey. The additional equipment required to produce whey powder requires additional capital. This additional capital impacts the business in two ways: additional interest costs and additional depreciation.

Additional equipment required for a whey plant relative to a butter-powder plant, assuming both plants receive 2 million pounds of raw milk per day, are:

Additional Equipment	Total Cost ($MM)
Two clarifiers	$ 0.70
Two separators	0.70
Evaporator/ bldg/services	1.80
6 crystallizers / with controls and cooling piping	1.20
Additional fluid bed / bldg / services	1.20
Total	$5.60

Operating 350 days each year, this plant could produce roughly 40.9 million pounds of whey powder annually. Spreading the $5.6 million of additional capital costs over this 40.9 million pounds of whey powder, using an 8% cost of capital, the additional cost of capital in a whey powder operation is 1.1 ¢/lb of whey powder. Amortized over 20 years, annual depreciation for the additional equipment is approximately 0.685¢/lb of whey powder.

In summary, incremental whey energy & equipment costs associated with producing whey powder as compared to producing NFDM is 2.559¢.

Source	¢/lb of whey powder
Energy	0.774
Capital	1.100
Depreciation	0.685
Total	2.559

As I stated earlier, the additional equipment in whey operations requires other costs such as extra labor to run the equipment, additional maintenance, as well as increased overhead costs. My testimony only covers the additional energy and equipment costs in whey processing, however these other operating costs should not be overlooked.