Milk Pricing Bases

methods of pricing manufacturing and market milk suggested

James B. Hassler and D. A. Clarke, Jr.

The following article is the second in a two-part report on a study of the pricing of milk on the basis of fat and skim milk.

Milk pricing practices followed in the dairy industry should depend on the association between milk composition—fat and nonfat solids—and the related values in utilization.

Pricing of milk, therefore, requires—besides the accurate measurement of the initial milk components—the measurement of the net value of milk in a given operation. As the raw milk changes in composition, information must be available about the relationship between milk composition and physical yields as well as product prices and processing costs.

The net value of 100 pounds of milk of a given composition in a given use can be determined. It is equal to the gross sales value of the resulting products minus the associated processing and marketing costs. Since specific standards have been established by state and federal governments for the fat, nonfat solids, and moisture content of nearly all dairy products, it is possible to estimate the product yields from 100 pounds of milk when reasonably accurate measurements of the raw milk components are available.

By employing the California relationship between nonfat solids and fat in whole milk—nonfat solids = 7.07 + .444 fat—to estimate nonfat solids content in 100 pounds of milk of a given fat test, product yields can be expressed as simple linear functions of the original fat test.

An illustration of the development of these yield equations and their application to pricing formula is given in the box on the bottom of this page.

The milk prices developed in this report are for the plant location, but farm prices can be determined by subtracting the transportation costs per 100 pounds of milk from the plant price schedule. Although some existing hauling rates are

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Price Relationships for Manufacturing Milk

Operation	General results*	Special example†
Butter and dry nonfat solids	$P = (1.23F^{**} - .123)(P_b - C_b) + (7.17 + .441F)(P_n - C_n) - C_{rs}$	P = .441 + .80F
	$BFD = .123(P_b - C_b) + .044(P_n - C_n)$	BFD = $.080
Evaporated milk		
(a) For F less than 3.9	$P = (.291F - .023)(P_e - C_e) + (7.14 - 1.85F)(P_n - C_n) - C_{rs}$	P = .417 + 1.13F
By-product of dry nonfat solids	$BFD = .029(P_e - C_e) - .185(P_n - C_n)$	BFD = $.113
(b) For F greater than or equal to 3.9	$P = (.013F + 1.05)(P_e - C_e) + (1.24F - 4.78)(P_b - C_b) - C_{rs}$	P = 1.270 + .82F
By-product of butter	$BFD = .0013(P_e - C_e) + .124(P_b - C_b)$	BFD = $.082
40% cream and	$P = (2.48F - .248)(P_{40} - C_{40}) + (99.248 - 2.48F)(P_s - C_s) - C_{rs}$	P = .794 + .85F
Separated skim milk	$BFD = .248[(P_{40} - C_{40}) - (P_s - C_s)]$	BFD = $.085

* Symbols mean: P (price of 100 pounds of milk); F (fat test of milk); BFD (butterfat differential or the value change of milk for .1% change in fat); C_{rs} (joint costs of receiving and separating 100 pounds of whole milk—assumed equal in all operations even though separating costs would vary slightly); P_b, P_n, P_e, P_{40}, P_s (selling prices for butter, dry nonfat solids, evaporated milk, 40% cream and skim milk—all on a pound basis, except evaporated milk with the 49–14½ oz. case as its unit); C_b, C_n, C_e, C_{40}, C_s (direct processing costs associated with the defined products and on the same weight-unit basis).

† For the special example, the following arbitrary values for the variables were employed:

$P_b = \$.665$ $P_n = \$.170$ $P_e = \$6.25$ $P_{40} = \$.360$ $P_s = \$.0119$ $C_{rs} = \$.200$

$C_b = \$.050$ $C_n = \$.070$ $C_e = \$2.05$ $C_{40} = \$.008$ $C_s = \$.0010$

** Yields of products are given in the parenthetical expressions containing the symbol F, the specific product in each case being indicated by the subscript immediately following (thus, F followed by P_b, indicates yield of butter).

EXAMPLE OF BUTTER-POWDER OPERATION

The terms in the first line of the above table (1.23F − .123) and (7.17 + .441F) represent the pounds of butter and dry nonfat solids that can be produced from 100 pounds of milk having a fat test of F%. These yields take into account an 80% fat standard for butter, the fat remaining in the skim milk, and reasonable physical losses. Buttermilk solids have been aggregated with the skim milk solids.

The terms $(P_b - C_b)$ and $(P_n - C_n)$ are net prices for butter and dry nonfat solids—equal respectively to the plant selling price minus direct costs of processing per unit of product. The term C_{rs} is the receiving and separating costs per 100 pounds of milk—assumed not to vary with the fat test. When the physical yields are multiplied by these net prices and C_{rs} is subtracted from the sum of the product net values, the net value of 100 pounds of milk is obtained. This is given in the column General Results.

The equation P = $.441 + $.80F in the column Special Results is obtained when the specific prices and costs are substituted in the general net value equation. When the value of F is known for a given lot of milk, the price per 100 pounds of this milk can be secured by substitution for F in this equation. For F = 5%, P = $4.44.

Development of product yields in an evaporated milk operation are more complicated since the standards for the product specify both fat and nonfat solids content. By-products of dry nonfat solids or butter could result if the fat-nonfat solids ratio in the raw milk is too high or too low compared with the standard for evaporated milk. The equations in the table are interpreted in a manner similar to that explained above for the butter-powder operation. Evaporated milk yields are expressed in cases, while all other products are given in pounds.

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on a per-pound-fat basis, it is believed that such rates treat high and low fat producers inequitably and that hauling rates should be related to pounds of whole milk—or cans of whole milk—and not to pounds of milk fat.

This section deals with procedures that might be employed in establishing the Class I prices for milk fat and for the skim milk. However, the previous developments might be used in the pricing of surplus over Class I.

Accepting the established base price for 100 pounds of milk of 3.8% fat test, the price schedule for other tests of milk must be determined.

Fluid milk operations are different from plant to plant because of the diversity in the composition of output. This variability prevents one from employing a simple net-value approach to the Class I pricing problem. Consequently, one must seek some economic factors in the dairy industry which might be employed as indicators of the values of milk fat and skim milk in Class I uses. Two procedures of approaching this problem are given in the table on this page.

The first procedure assumes that the relative prices of all dairy products tend to remain fairly stable through utilization shifts and that the relative values of fat and skim milk in some other alternative dairy operation should be a fair indicator of the relative values of these components in fluid uses. The relative values of these two components could be determined for milk of 3.8% fat test when used as an alternative dairy operation and then applied to the basic Class I whole milk price to determine separate values for Class I fat and skim milk in 100 pounds of base test milk. Prices per pound of Class I fat and skim milk would be secured by dividing the latter values by the 3.8 and 96.2 pounds of fat and skim milk in a hundredweight of 3.8% milk, respectively.

If the nonfat solids content of the skim milk should be reflected in the Class I skim milk price, then the skim milk price should be converted to a nonfat solids value. The conversion factor would be $^{96.2}/_{8.76}$. This value could be applied to the nonfat solids content of skim milk at other fat tests to secure the entire Class I whole milk pricing schedule.

If, on the other hand, the value of skim milk for Class I uses is not affected by differences in nonfat solids content, then the initial component prices should be applied directly to the amounts of fat and skim milk per 100 pounds of whole milk to get the Class I pricing schedule.

The second procedure recognizes that sanitary and institutional barriers in the Grade A market as well as fairly rigid Class I product prices relative to other dairy products tend to reduce the validity of the first procedure. The second procedure employs a price indicator in the Grade A market which is free of administrative pricing and, consequently, should reflect distributor evaluations in a market area. This indicator is the Grade A jobbing price for 40% cream. Legally and physically, it has the same components as Class I whole milk except that the proportions are different. Consequently, if one adjusts this cream price back to a plant-entry level by making allowances for physical losses and processing costs, this adjusted cream price can be used with the basic 3.8% whole milk price established by the Bureau of Milk Control in conjunction with the differing fat and skim milk percentages for the two products to secure Class I prices for fat and skim milk. With allowances for locational differences from the areas where the cream prices are quoted, this procedure could be adjusted to meet geographic pricing problems.

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Class I Prices for Fat and Skim Milk Components of Whole Milk (General Results)

Item	Procedure 1* skim milk differentiated	Procedure 1* Skim milk not differentiated	Procedure 2
Fat price (P_f) per pound	$\frac{P_{3.8}(RV_f)}{3.8}$	$\frac{P_{3.8}(RV_f)}{3.8}$	$\frac{96.2\,V_{40} - 1.5\,P_{3.8}}{90.5}$
Skim milk price (P_s) per pound		$\frac{P_{3.8}(RV_n)}{96.2}$	$\frac{P_{3.8} - 3.8\,V_{40}}{90.5}$
Class I Nonfat solids price (P_n) per pound	$\frac{P_{3.8}(RV_n)}{8.76}$		
BFD	$.1\,P_f + .044\,P_n$	$.1\,P_f - .1\,P_s$	$.1\,P_f - .1\,P_s$

* The butter-dry nonfat solids operation is the alternative considered here. Any other alternative operation could be employed.

$RV_f + RV_n = 1$, means (Relative value of fat) + (Relative value of nonfat solids) = 1.

$$RV_f = \frac{4.55\,(P_b - C_b)}{4.55\,(P_b - C_b) + 8.85\,(P_n - C_n)} = \frac{\text{net value of butter}}{\text{net value of butter + net value of nonfat solids}}.$$

V_{40} is the 40% cream price expressed on a per pound of fat basis and adjusted for plant losses and processing costs.

$P_{3.8}$ is the base Class I price per hundredweight of whole milk.

ALFALFA

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2. The average rate of gain of a group of steers fed alfalfa hay containing 0.24% phosphorus grown on a soil which had been phosphate fertilized was slightly greater than a similar group fed unfertilized hay containing 0.19% phosphorus, but the difference was not statistically significant. The yield response obtained by phosphate fertilization had indicated that this soil was moderately deficient in phosphorus.

3. Alfalfa hay grown on an extremely phosphate-deficient soil and containing 0.10% phosphorus—when free-fed to steers—can significantly lower the blood phosphate level.

4. The unpalatability of the hay and poor rate of gain of the steers fed this particular hay of extremely low-phosphorus content was not corrected by supplemental feeding of phosphate salt for 27 days.

Additional information is needed to show whether this is a problem of phosphorus requirement of the animals or whether secondary factors such as palatability are involved.

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Average Phosphate Phosphorus Content of Blood Serum from Steers Fed Alfalfa Hay Varying in Phosphorus Content. Phosphorus Expressed as Milligrams per 100 Milliliters of Serum

	First test 96 days Start	First test 96 days End	Second test 96 days Start	Second test 96 days End	Third test 96 days Start	Third test 96 days End
High P hay lot	8.07	8.80	8.13	7.32	7.32	6.90
Low P hay lot	7.53	7.46	8.15	4.79	4.79	8.28