LOSSES IN U.S. FOOD DISTRIBUTION SYSTEM

DAIRY PRODUCT LOSSES

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PREFACE

This is one of eight reports resulting from a study of losses and waste in food distribution. The National Science Foundation-Research Applied to National Needs (NSF-RANN) commissioned and provided primary funding for the analysis of the general magnitudes and locations of food losses occurring in the U.S. food distribution system. Additional resources were provided by Michigan State University's Agricultural Experiment Station and Cooperative Extension Service. Seven food product categories have been analyzed: fresh beef, produce, dairy products, dry grocery, frozen foods, bakery goods and foods sold through delicatessen departments. Foods within these categories constitute about 92 percent of supermarket dollar food sales. Dry grocery is the largest category, accounting for about 36 percent of supermarket food sales. It is followed by dairy products at about 15 percent, fresh beef at about 13 percent, and produce at about 9.8 percent of food sales. Frozen foods, "deli" department foods, and bakery goods accounted for 8.1, 5.2, and 4.7 percent respectively. It should be noted that with the exception of fresh beef, the categories are designated according to conventional food store departments. In the case of beef, it is the dominant product in the meat department.

This particular report contains: an introduction and orientation to dairy product distribution through supermarkets; a discussion of the general nature of dairy product losses; and findings of the magnitudes, causes and suggested remedies for dairy product losses. The following companion reports also derived from the NSF-RANN study complement this report.

- Losses in the U.S. Food Distribution System
- Produce Losses in the U.S. Food Distribution System
- Delicatessen Food Losses in the U.S. Food Distribution System
- Dry Grocery Losses in the U.S. Food Distribution System
- Fresh Beef Losses in the U.S. Food Distribution System
- Frozen Food Losses in the U.S. Food Distribution System
- Bakery Losses in the U.S. Food Distribution System.

DAIRY PRODUCT LOSSES IN THE U.S. FOOD DISTRIBUTION SYSTEM

CONTENTS

INTRODUCTION

The reality of serious resource shortages coupled with stagnant productivity over the past decade has led to a renewed search for ways to improve efficiency in the U.S. economy. The productivity problem and resource shortages have been important factors in creating the nation's most serious economic problem -- inflation. Among the most visible symptoms of inflation are rising gasoline and heating fuel costs as well as food price increases. Rapid food price increases and the hardships they poose for society highlight the necessity to improve productivity and resource utilization in the food distribution system. Among the many resources used in the distribution foods -- labor, energy and capital, to name just a few -- food itself must be included as a vital resource. Thus, food firms need to develop and implement more "food efficient" distribution methods within an overall context of cost efficiency.

At the present time, however, the nature of food losses in the distribution system is often not well understood. Neither the magnitudes nor the locations of food losses have been adequately documented. Even definitions of the terms differ greatly. Nonetheless, until the magnitudes and locations of the losses are established, opportunities to take action to reduce them are severely limited. This report presents preliminary estimates of dairy product losses in the U.S. food distribution system.

The Nature of the Research

"Dairy product losses" is a term subject to many interpretations. The purposes and nature of this study dictated the use of a number of different

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*In addition to the principal authors, major contributions to this report were made by Cynthia M. Seik, Graduate Assistant, Department of Marketing and Transportation Administration, Michigan State University.

"dairy product losses" terms and concepts: (1) losses by weight, (2) economic value of physical losses, (3) total economic costs associated with losses, (4) shrinkage, and (5) losses resulting in reductions of either the quantity or quality of dairy products available for human consumption. Although different "dairy product loss" concepts with disparate data were used, the study tended toward a single focus: an effort to develop estimates or proxies for the quantities of dairy products lost for human consumption. This project covered dairy product distribution activities starting from the processor's shipping dock, extending through transportation and wholesaling, and ending with supermarket retailing operations.

Losses of dairy products available for human consumption refer to those products commonly distributed through the contemporary marketing and distribution systems. Thus, products which are customarily and purposely discarded, such as whey, have not been included as losses, even though it may be edible and nutritious.

The specific objectives of the study were:

-- To identify the general magnitudes and locations of major dairy product losses during distribution activities based upon a thorough inventory of available information.

-- To determine the approaches currently used to control dairy product losses, and to assess the strengths and weaknesses of these approaches.

-- To identify dairy product loss issues which may need additional research in order to reduce losses.

Research procedures employed to achieve these objectives involved a four-step process:

-- An initial, broad-based survey of published information was conducted. Sources of information included: (a) university, United States

Department of Agriculture and private industry-sponsored symposia on food losses and related topics; and (c) trade publications.

-- A select panel composed of representatives from industry, trade associations, and government met at Michigan State University to review and comment upon the preliminary findings. They also contributed to the identification of comprehensive resource materials.

-- The analysis and synthesis of selected published data was conducted in order to develop a comprehensive picture of dairy food losses.

-- A limited number of in-depth interviews were carried out with selected industry authorities to provide additional information, and to ascertain the reasonableness of findings.

Six top selling items from the supermarket dairy case were selected for primary focus in this study of losses and wastes incurred in dairy product distribution. The items are fluid milk, cheese, eggs, margarine, butter and cottage cheese. In most respects, an understanding of the circumstances surrounding losses and wastes in the distribution of these six items provides a general overview of the loss and waste situation confronting the majority of products merchandized through the supermarket dairy department. Recent supermarket sales and performance data on dairy products and eggs are shown in Table 1.

In 1977, milk, cheese, eggs, margarine, butter and cottage cheese accounted for over 87 percent of total dairy department sales (including ice cream) in supermarkets. Dairy department sales were about $14.7 billion; or slightly over 15 percent of retail food sales through supermarkets.

Marketing Channels for Dairy Products and Eggs

The degree of losses experienced by dairy products and eggs is in many respects a function of the nature of the marketing channels through which these

Table 1. Dairy Products: 1977 Performance in Supermarkets[1]

	Sales				Profit		Assortment	Margin
	Dept. Sales	1977 Dollar Volume	1976 Dollar Volume	Diff.	Dept. Gross Profit	Gross Profit Dollars	Dept. Brands & Sizes	Average Gross Margin
	(percent)	(millions)	(millions)	(percent)	(percent)	(millions)		(percent of retail)
*Fluid Milk Products	29.18	4,303.20	3,789.52	13.56	27.00	886.46	7	20.6
Yogurt	3.68	541.55	499.31	8.46	3.80	125.10	63	23.1
*Eggs	16.22	2,392,04	2,171.90	10.14	10.85	356.41	10	14.9
*Cheese	16.45	2,425.96	2,285.02	6.17	20.91	686.55	179	28.3
Ice Cream	11.62	1,713.88	1,549.74	10.59	13.78	452.46	58	26.4
*Margarine	6.42	947.00	917.36	3.23	6.06	198.87	41	21.0
*Butter	4.69	692.13	673.51	2.76	3.60	118.35	11	17.1
Refrigerated Juices and Drinks	2.68	395.93	313.53	26.28	3.17	104.13	27	26.3
Refrigerated Dough Products	1.81	266.33	224.12	18.83	2.08	68.18	51	25.6
Refrigerated Salads	0.04	6.17	10.45	-40.95	0.06	1.85	2	29.9
Fish & Fish Snacks	0.44	65.35	46.45	40.69	0.58	19.02	21	29.1
Toppings	0.33	49.32	39.43	24.92	0.40	13.12	6	26.6
Yeast	0.06	8.63	10.45	-17.41	0.08	2.08	2	30.8
Party Snacks	0.59	86.31	85.93	0.44	0.83	27.18	30	31.4
*Cottage Cheese	4.03	594.31	448.23	32.59	4.62	151.55	31	25.5
All Other Dairy Case Items	1.76	258.93	186.95	38.50	2.18	71.72	33	27.7
Total	100.00	14,747.04	13,251.95	11.28	100.00	3,283.53	572	22.3

Source: See (3).

[1]Supermarkets are defined as stores with sales of at least one million dollars.

*Items selected for primary focus in this study.

products are distributed. Therefore, it is appropriate to consider the marketing channels for dairy products. A 1975 study showed that almost 90 percent of all milk products in recent years was of Grade A quality. More than half of the Grade A production was processed into fluid milk. National firms processed approximately 23 percent of this subtotal, regional firms 7.5 percent, local firms 37.5 percent, cooperatives 11.9 percent, and integrated retailers around 20 percent. Retailer-processed milk can be distributed directly to retail stores or through distribution centers, and then on to the retail level. Milk processed by others may be distributed through processor-owned or independently-owned operations, and may be distributed via home delivery, direct delivery to retail or through distribution centers to retail stores.

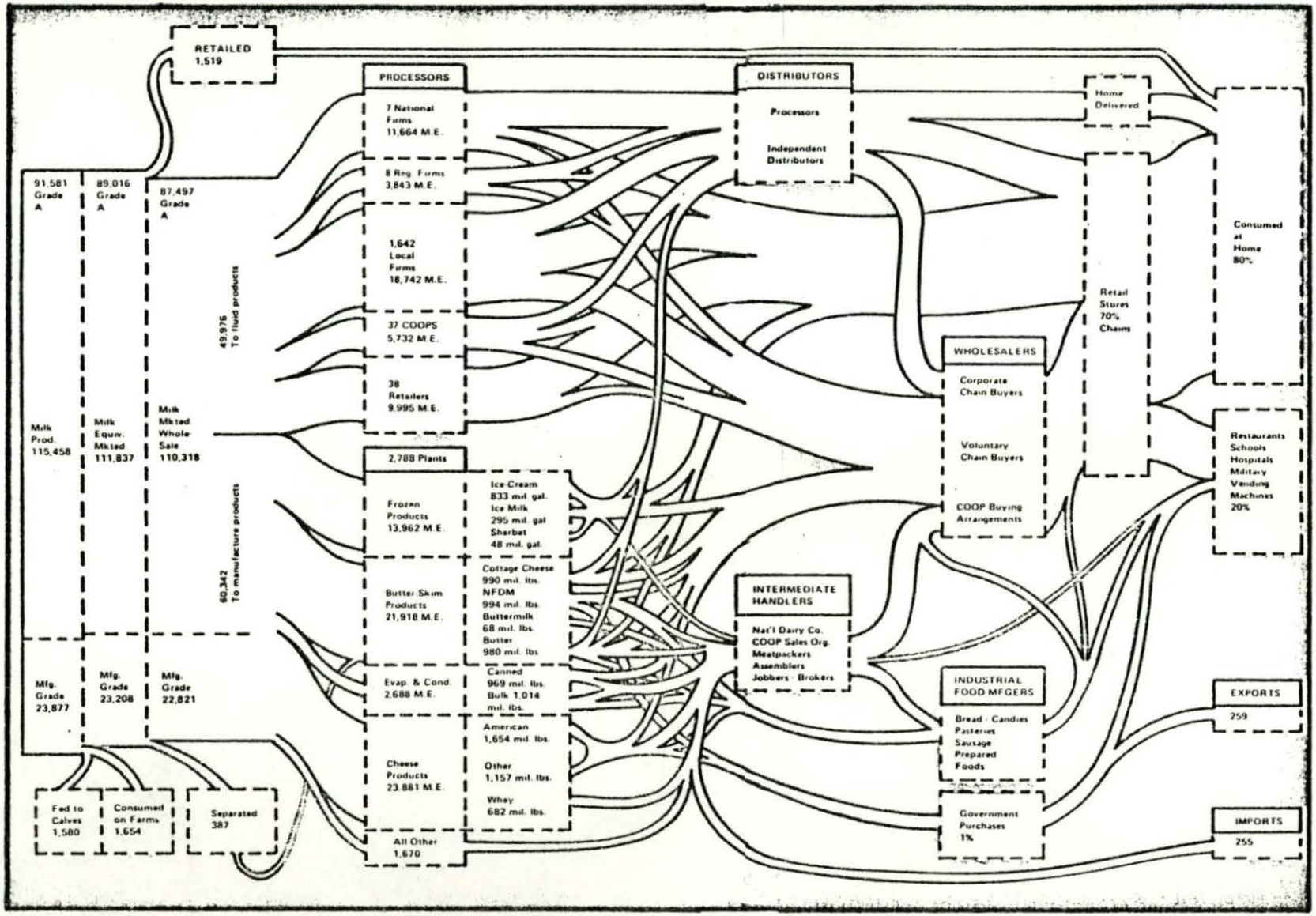
Manufacturing-grade milk and Grade A milk not used for fluid milk represented approximately 55 percent of all milk marketed at wholesale. Processors of cottage cheese and other manufactured dairy products prefer Grade A milk, as it imparts longer shelf life, thus tending to minimize losses.

Figure 1 shows the distributional flow of milk and related products. The flow of manufactured milk products is more involved than it may appear since some of the products are used in the further manufacturing of other dairy and food products.

The distribution of milk has changed dramatically since the early 1950s. Today home delivery has almost ceased to exist. What remains is performed mainly by independent distributors who receive milk at the processing plant dock. In addition to home delivery, some independent distributors also service small stores.

Another trend in milk distribution has been that of retail food chains increasingly integrating into processing activities. According to a 1976 study, 20 percent of all packaged products were produced and distributed by integrated

Figure 1. Distributional Flow of Milk and Related Products



Source: See (14).

retailers. Another large proportion of total packaged milk products (about 25 percent), was distributed through non-integrated retail supermarkets, including corporate and voluntary chains, and cooperative buying groups.

The distribution of manufacturing grade milk varies according to the finished food product in which it is used -- butter, cheese, evaporated and condensed milk, etc. Butter, for example, intended for retail distribution, undergoes many distribution functions including grading, assembly, storage, sorting, printing, advertising, exchange operations, and final delivery to retailers. Generally, substantial integration of these functions occurs, especially when performed by some of the large dairy cooperatives. Butter is usually assembled in a central plant where it is graded and sorted, prior to shipment to wholesale facilities; or directly shipped to retail stores. The large cooperatives, such as Land-O'-Lakes, service retail stores regularly to ensure that stocks are properly rotated and to maintain fresh inventories (14). However, it appears that the general practice of manufacturers' servicing the retail dairy case may be declining due to retail union restrictions and high costs. If manufacturers' presence at the retail level of distribution does diminish, losses of dairy products may increase unless standards for stock rotation and quality control can otherwise be established and maintained by retailers.

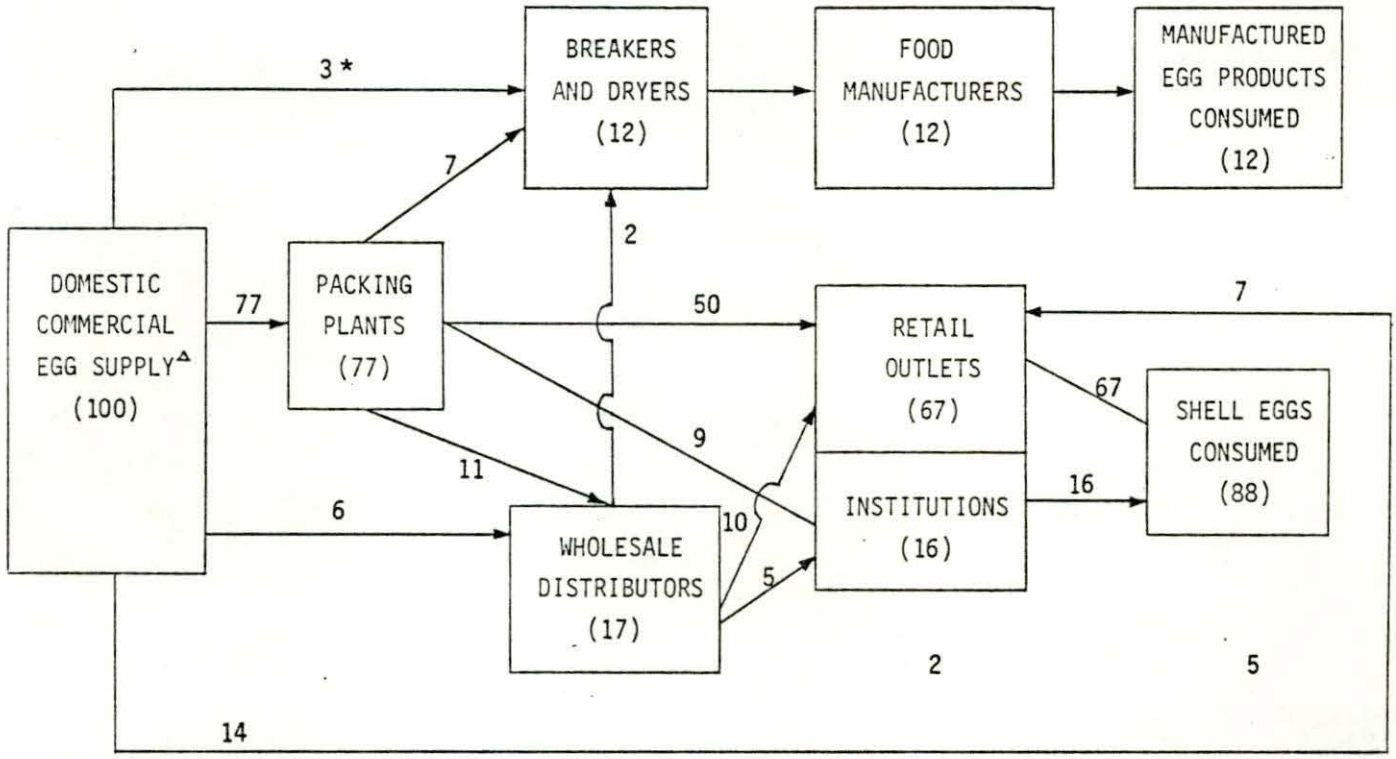
The intermediate phases of distribution for cheese are somewhat more complex than those for butter. Cheese is purchased from manufacturers for distribution as packaged cheese or for use in processed cheese products. It is first assembled and sorted into uniform lots. At this stage of distribution there are few independent handlers, as the industry has become highly integrated. These large firms assemble cheese after its initial processing. Integration in cheese marketing, having reduced the number of firms cheese must pass through during distribution, has consequently reduced handling losses. After the

intermediate handler, cheese may be distributed to wholesaling firms, which in turn serve supermarkets (50).

Marketing channels for eggs have also undergone major changes in recent times; characterized by increased simplification. Channels are more direct and involve fewer firms compared with two decades ago. Accompanying this reduction of firms has been a shift in the packaging; i.e., cartoning of eggs from locations of consumption to areas much closer to points of production. This has led to the replacement of intermediate institutions by packing plants as the predominant procurers of eggs from producers. Diminished are the roles of wholesalers, receivers, commission houses and jobbers, all of whom handle reduced volumes today. Accompanying these changes has been a progressive improvement in the quality of eggs moving in distribution from packers to consumers. Finally, there has been a trend toward greater vertical coordination and integration resulting in closer ties between the input-supply, production, packaging, and distribution phases. In the process of increased vertical coordination, firms have integrated in both forward and backward directions; the extent of each type of integration depending upon firms' initial positions in the marketing channel. This has led to the emergence of multi-function firms which defy simple categorization in traditional terms (60). A flow chart showing the commercial egg marketing channels is shown in Figure 2.

Primary egg marketing is conducted by those firms which perform the assembly, packing, and cartoning functions. Typical examples of these types of firms are packing plants, wholesale distributors and direct marketing producers. Packing plants handle the largest volume with over three-quarters of the total volume, followed in importance by direct marketing firms and wholesale distributors (60). It should be noted that the relative positions of packing plants and wholesale distributors have reversed over the course of the last two decades.

Figure 2. Egg Distribution Through Commercial Marketing Channels, 1971-72.



△excluded exports, imports, eggs consumed on farms where produced, and eggs used for hatching. *percentages of domestic commercial egg supply.

Source: See (60).

Secondary marketing firms receive their supplies from primary egg marketing firms and, in turn, market to consumers. Supermarkets are secondary marketing firms and they handle nearly two-thirds of the commercial egg market volume (60). Retailers are supplied principally by packing plants. Chain and independent retailers, most of whom own or are affiliated with wholesaling operations, are by far the most important firms in this group.

QUALITY DETERIORATION IN DAIRY PRODUCTS AND EGGS

From the moment dairy products are produced, they begin to deteriorate in quality. This phenomenon is true to some extent for most food products. Numerous studies have been conducted on the nature of quality deterioration in both dairy products and eggs. The great majority of these studies have been clincial and technical in nature. Although there is little data on losses, per se, the studies are valuable for their insights concerning the fundamental causes of losses and possible means of loss reduction.

In the early 1950s, a number of comprehensive studies were conducted on eggs to determine costs associated with interior deterioration and shell damage. Since that time the state of the science has advanced substantially. Currently, due to improved technology, interior damage has been minimized; however, shell damage still remains a concern. Dr. Henry Larzelere, Michigan State University, observes, "shell damage continues as a concern since the mechanical handling and washing procedures cause breakage . . ." (22).

A number of recent studies indicate the major causes for quality deterioration and the curently available technology to reduce quality deterioration. Genetic improvement of poultry and more effective storage operations have resulted in reductions in interior deterioration of eggs. For example, studies conducted by Texas A&M University reported that immediate refrigeration aids greatly in the preservation of interior quality of eggs (24,25). It also was found that packages preventing moisture loss were useful to minimizing weight loss (7). A University of Wisconsin study determined that temperature and humidity were the two most important factors in controlling quality losses; and that circulating cool air was more efficient in the refrigeration of eggs than stagnant cool air (27). California researchers found a correlation between the

method of egg washing and increased bacteriological contamination. They recommended regular changing of the immersion medium to reduce contamination (48).

To determine the costs associated with egg deterioration, it is apparent that further field studies may be necessary. Yet even with greater information resulting from such studies, assessments of costs may be difficult to achieve.

> . . . Product deterioration in both quality and egg condition is an important production and marketing cost of eggs, which is not easily assessed when customary costs are considered. In accounting terms, the costs of quality deterioration appear as decreased in gross margins rather than as increases in specific marketing costs. (22)

In dairy products, as with eggs, many clinical studies have been conducted to determine nutritive deterioration as well as other traditional quality factors. For the most part, quality of dairy products encountered in retail outlets is excellent. There is evidence, however, that in some instances quality could be improved. Gregory states, "In this era of modern processing and technology the likelihood of a problem with the safety of milk and dairy products is remote. However, one cannot make the same statement regarding the maintenance of high quality" (18). Similar findings were noted in a two-year study in Connecticut, although the results were not as dramatic (19).

Most of these criticisms relate to flavor factors. Generally, the so-called "mishandling" of milk and dairy products is the principal source of the flavor problem. Much of the "mishandling" occurs between the processor and consumer point of purchase at retail, but a substantial share of improper handling also occurs in the home.

The most common form of "mishandling" during distribution is improper temperature maintenance, the key to shelf life (18,28). A shelf life of two weeks can be expected for fresh fluid milk when continuously refrigerated below $40^{o}F$. Shelf life is reduced with increased temperature (18). Naturally, the handling of milk at the processing plant, and during all other phases of

distribution also affects shelf life. Thus, quality control must be treated as a systems issue.

Nutritive quality also may be affected by handling techniques. For example, certain nutritive substances are adversely affected by improper temperature control. Studies also have shown the deleterious effects of flourescent light upon nutrient maintenance. In one such study paperboard versus plastic packages were tested to determine the effects of each package on milk subjected to flourescent lighting. The longer the milk was under the influence of the light, the greater was the destruction of nutrient contents in each type of package. No significant difference between the two types of containers in preventing nutrient destruction was found, with the exception of Vitamin B_6. In this case, the paperboard container was found to be substantially more protective (20). Other evidence does, however, indicate that any light-sensitive vitamin will be protected by paper containers. The significance of each of the studies cited is that with proper handling techniques, quality and nutritional deterioration can be kept at a minimum.

LOSSES DURING TRANSPORTATION OPERATIONS -- PROCESSOR TO DISTRIBUTION CENTER

Published sources of information concerning losses of dairy products and eggs during transportation from processors and manufacturers to the distribution facilities were few in number. One possible explanation for the lack of data is that many dairy products are exempt from Interstate Commerce Commission (ICC) regulations, and thus shippers are not obliged to submit loss data (63). In addition to the exempt status of dairy commodities, historically, transportation costs of such products, other than milk and eggs, account for only 2 to 3 percent of the retail selling price. Thus, losses occurring in transit are not substantial components of the overall cost structure.

A major trend in dairy product transportation over the last twenty years has been the increased reliance on truck transportation, at the expense of the railroads. With the ponderance of truck transit, the Federal State News Service discontinued reporting dairy product unloads by mode of transport in the late 1950s. By 1962, most of the dairy products delivered to New York City wholesalers arrived by truck. Indeed, 92 percent of the total tonnage arrived by truck; and only butter and margarine were delivered in appreciable quantities by rail (64). Of the several USDA studies of metropolitan dairy wholesaling facilities conducted in the 1960s, the lowest portion of dairy products which arrived by truck was 78 percent (45). The volume of dairy products handled by trucks today has undoubtedly increased. Nyberg noted that in 1973 truck transportation accounted for almost 100 percent of all dairy product shipments (30).

Most of the suggestions for preventing losses during transportation require the application of relatively simple and widely recognized recommended practices. Rapid and efficient movement of properly refrigerated products appears to be the most important of these basic, common-sense factors. Many in the industry believe that most dairy product rejections at wholesale and retail facilities occur due to a lack of adequate refrigeration. Suitable refrigeration equipment capable of maintain constant and proper temperatures is, of course, necessary for quality assurance during the transportation of dairy products. If dairy products are loaded and shipped at other than optimal temperatures nutrient and quality deterioration occurs (36). In addition to adequate refrigeration equipment, an interrelated complex of appropriate packaging, and materials-handling procedures and practices are essential to loss reduction. Adequate packaging and materials-handling includes such factors as the consideration of packaging suited to load requirements, handling equipment, and the training and motivation of employees by management.

LOSSES DURING WHOLESALING OPERATIONS

In this section dairy product losses occurring during the wholesaling operations are explored. These activities include receiving at the distribution center, storage, selection and shipment to retail stores.

Estimates of losses at wholesale are based on USDA studies of wholesale facilities in various cities, conducted from 1962 to 1974 (38,40,42,43,44,45, 46,47,63). While some of the figures are dated, several key, loss-related problems cited in the earliest studies appear to be common to even the most recent studies.

The purpose of the these studies was to investigate problems of wholesale facilities and suggest how cost reductions might be achieved through the construction of new facilities. Although the number and variety of causes for spoilage, breakage and product deterioration varied among the facilities, the two major causes -- excesive handling and inadequate refrigeration facilities -- were common to all. In general, products went through excessive handling steps in the wholesaling phase of distribution. Also, many of the wholesalers' outdated refrigerated storage facilities failed to maintain product at adequate temperature levels.

The 1963 study of a major wholesale facility in Detroit revealed costs of $1,040,300 per year associated with egg and dairy product handling, cartage, rentals, waste, spoilage, product deterioration and other charges. Spoilage and deterioration costs were estimated at about 10 percent of the above total costs (38). Tonnage losses amounted to .5 percent of the total volume handled. The reduction of spoilage costs projected for a recommended new facility was 16 percent.

A similar study made in the Pittsburgh wholesale market in 1964 included butter, margarine, cheese and eggs; but not fluid milk. The total annual volume of commodities received was 60,700 tons. Spoilage was about one percent of total volume. As was the case in the USDA Detroit study, the major causes for losses were excessive handling and inadequate refrigerated storage facilities. It was estimated that spoilage costs could be cut by about 31 percent through the construction of new facilities utilizing available equipment and refrigeration technology (44).

A 1965 Springfield, Massachusetts study conducted by the USDA yielded results similar to those found in Pittsburgh and Detroit. Total cost of handling dairy products and eggs amounted to $335,000 per year. Spoilage and breakage was about 6 percent of total volume. New facilities were projected to eliminate 40 percent of total annual spoilage costs (45). Once again, the major causes for losses were excessive handling and inadequate refrigerated storage facilities.

In each of these USDA case studies, estimates of dairy product losses were based upon: (1) estimates obtained from wholesaler executives who kept records, (2) estimates of wastes at the facilities, and (3) information from waste removal services. Clearly, such estimates were subject to some error and inconsistency; however, the findings appear useful. The studies established a range of dairy product tonnage losses at wholesale, .5 percent to 1 percent. Secondly, they suggested that the major causes for losses, excessive handling and inadequate refrigeration facilities, can be remedied by replacement of facilities.

A summary of losses data from the USDA case studies indicated the following: (1) Total spoilage costs comprised about 5-10 percent of the wholesale handling costs of eggs and dairy products. (2) Tonnage losses ranged from .5 percent to 1 percent of total volume handled. It should be noted, however, that spoilage losses may have been less significant in the analyses conducted during the 1970s

since such losses were not specifically identified in these more recent studies. (3) The proposed new facilities in all cases, with the exception of the most recent studies, were projected to make significant contributions to the reduction of spoilage costs; reductions of between 16-54 percent. Most of the reductions could be achieved through less handling and by improved refrigerated storage facilities (38,44,47).

In addition to losses incurred in distribution center activities, losses also occurred during transit between the distribution centers and retail stores. Although published data were not available, a Midwestern chain executive reported that for some dairy products as much as 80 percent of total losses incurred in all wholesale and retail activities might be attributed to this link in the distribution channels. Losses during transit to supermarkets were due to several factors. It was assumed that in most instances temperature failure was the major cause, although losses also resulted from inadequate packaging and handling methods.

Proper temperature control is extremely important during this transportation phase if maximum product shelf life is to be maintained. It requires that both the product and the truck trailer be cooled to the appropriate temperature prior to loading. Many successful wholesalers regularly check the operating temperatures of their trucks during transit from the distribution center to retail stores. One operator, for example, requires that the ambient temperature of loaded trailers be checked every four hours.

Inadequate packaging, another cause for in transit damage, refers to primary and secondary containers that are not designed to withstand the level of stress placed upon them during high volume, mixed-load shipping. This type of packaging failure was cited as a principal cause for high losses during the delivery of cottage cheese, yogurt and eggs. However, it was also suggested by

some that present packaging alternatives to reduce these losses would cost more than the current cost of losses. The packaging component becomes even more critical when packages are palletized and stacked for the purpose of fully utilizing trailer cube for the most economic utilization of transportation equipment.

In transit losses due to poor handling result from: (1) the difficulty of assembling stable multi-product pallet loads for shipment, and (2) the failure of drivers to adequately redistribute loads after each delivery to avoid falling product. Clearly, these two closely related problems indicate the need for modularization of secondary containers. Modularization would facilitate more stable assembly of pallet loaded products and would reduce the need for the time consuming redistribution of loads between supermarket deliveries.

LOSSES DURING SUPERMARKETING OPERATIONS

The final phases of the commercial distribution channels included for study were supermarket operations. Retail activities relating to dairy products included: (1) receiving at the store dock, (2) temporary storage in the backroom, (3) storage in a backroom cooler and/or, (4) movement to the dairy case, (5) product pricing and stocking in the dairy case, (6) rotation of product in the dairy case, and (7) product selection by consumers.

Published information on dairy product losses at the retail level was difficult to obtain as it was for each of the preceding stages in the distribution system. The loss problem was recognized and alluded to in many trade press articles and some study reports; however, substantive information generally was lacking. Fortunately, some information was available to aid in the development of at least a general overview of retail dairy product losses and an estimated range of magnitudes for such losses.

In one instance, a Detroit supermarket chain of 53 stores was able to quantify product losses in the dairy case based upon records it maintained as part of its policy of returning damaged products to manufacturers and processors for credit. The firm estimated monthly spoilage to be $50 per store. As a percentage of average supermarket dairy sales, this is about .1 percent (4). When the $50 per month per store figure is multiplied by the number of stores in the chain an converted to a yearly basis, total annual dairy department losses for the chain were $31,800. This provided an indication of the magnitude of retail dairy losses for one firm.

In order to elaborate further and to develop a range of retail losses, findings of a USDA study of open dating conducted in 9 Ohio supermarkets were used. Dairy department losses reported were about 2 percent of retail dairy sales (49). One the other hand, executives of two major chains who were interviewed cited lower loss figures. One experienced losses of 1 percent; and the other, slightly over 1 percent of total dairy sales. Using these values, total U.S. losses in retail supermarket dairy departments in 1977 are estimated to have ranged from about $148 million to $295 million.

It should be noted that there is great variability not only in the magnitude of losses from one supermarket to another, but also within dairy departments, from one product to another. For example, a Rochester, New York, supermarket estimated losses on natural cheese to be .25 percent of sales (66). At the other end of the spectrum, several supermarket dairy department managers and a USDA study reported that the breakage rate on eggs approximated 3 percent of sales (60). At a 3 percent loss rate, 1977 losses on eggs in supermarkets would have been about $72 million. In the case of eggs, it should be noted that a large portion of the breakage was not revealed until the product was displayed at the

retail level, no matter where in the distribution channel the damage might have actually occurred.

In general, because of its large share of dairy case unit sales volume, milk contributes more to losses within the department than any other item. Even so, most reported loss instances for milk were less than 2 percent of sales, or less than $86 million in 1977. The main causes for milk losses were inadequate handling and so-called out-of-date merchandise. Where supermarkets' policies or local ordinances so state, milk that has reached its sales expiration date must be removed from display. Typically out-of-date products, which also are referred to as "stales", are destroyed even though they may retain flavor and nutrition content at the time of code expiration. However, at the expiration date regulatory authorities believe the product's useful shelf life as been reduced to the point where consumers would risk not having adequate shelf life in the home. In a sense, shelf life regulations, although intended to benefit consumers, do contribute to food losses. In situations where consumers used products within a short period of time after the expiration date, sale of the product would reduce losses with nominal risk to consumers. In addition to losses directly attributable to expired code dates, there is a lack of uniformity in regulations regarding these dates. One Midwest retailer is required by law to conform to substantially varying expiration periods in each of several different markets, thus increasing the costs of operation and imposing additional needless costs on the food distribution system.

Viewing the retail dairy department as a whole, the three most prevalent causes for dairy losses appeared to be: (1) inadequate temperature control, usually resulting from refrigeration equipment failure, or improper stocking techniques which inhibit cool air circulation, (2) out-of-date merchandise, which in most cases was the result of improper stock rotation or mismanaged inventories reflected by over ordering, and (3) rough handling resulting from

inadequate employee training and motivation, poor equipment, and a general absence of effective management supervision.

Once again, it should be noted that the causes for losses and magnitudes of losses, as well as suggested remedies, vary from firm to firm and store to store. For example, one chain indicated that out-of-date product was a significant problem creating losses of milk, as well as losses of many other dairy products. In order to minimize losses, the firm has attempted to gain greater control over the product and distribute it through the system more quickly. To do this the firm was vertically integrated into milk and other dairy product processing, by assuming ownership and management of the processing plant. In this manner the firm has gained quality assurance control over processing, as well as distribution center activities. In furthering its efforts to reduce losses by increased systems-wide efficiency, the firm also has employed a computerized ordering system for fluid milk. Ordering has been based on the programming of historical sales experiences which may be manually adjusted to meet special market situations such as holidays and unusual weather conditions. Company officials believed that without vertically integrated processing and distribution of this kind, and the computerized ordering system, losses would perhaps be doubled from the current 1 percent level.

It should be noted that an integrated system of the kind decribed does not appear to be essential to achieve relatively low levels of dairy department losses. Another Midwest retailer, without the benefit of processing operations and computerized ordering, estimated its dairy losses to be only slightly greater than 1 percent of dairy sales. Thus it appears that many factors combine to determine the need for such systems. Included in such considerations might be the size of the firm, the geographic dispersion of stores, the methods employed for distribution, the overall headquarters and store-level management skills,

and finally, the philosophies concerning the importance of loss reduction activities.

Other methods determined to reduce store-level losses included purchases of efficient refrigeration units, and the application of proper stocking methods of the dairy case. An overstocked case was observed to substantially reduce the efficiency of the unit, resulting in reduced shelf life of products. Rapid stocking and proper stock rotation of fast moving items was reported to be greatly facilitated by rear-loaded display cases. Such cases cannot easily be overstocked, and they help to ensure that products are displayed in proper rotation. As an added benefit the rear-loading refrigerated case can reduce per unit labor handling costs.

As noted above, types of packaging were related to loss experiences. In recent years, many packing innovations have become available to processors. Trends in milk packaging included the movement away from the use of glass toward paperboard; and more recently, the shift to plastic bottles. Paperboard container use increased until 1971, and has since decreased slightly relative to plastic (16). Plastic containers were observed to have the advantage of being cleaner and less prone to leakage (1,33).

Other innovations in milk packaging and handling which facilitated distribution and stock rotation were the development of the roll-in dairy cart and the three-sided wire milk container. This cart carries several hundred milk containers and can be wheeled directly into the dairy display case without the need for further handling, speeding transportation, facilitating stock rotation and reducing handling (9). The three-sided wire milk container also facilitated easier handling as consumers removed product directly from a stack of wire containers. Similar retail level innovations also were used in the merchandising of eggs.

SUMMARY AND CONCLUSIONS

Losses of dairy products and eggs constitute both substantial physical and economic losses. Table 2 provides a summary of estimated ranges of losses incurred during distribution of dairy products. The figures are based on secondary data and industry sources.

It is important to realize the limitations of these estimates. First of all, it should be noted that the ranges of losses are very broad. The ranges reflect substantial variations in practices and performance by firms in the dairy product distribution system. Moreover, the informational bases used to develop the ranges are too limited to assume average losses at the center of each range. Thus, representative averages cannot be determined from the data of Table 2.

Second, although aggregate U.S. dollar losses are substantial -- ranging from 72 to 413 million, it should be noted that by comparison individual incidents resulting in losses are relatively small. The majority of individual losses would probably be measured in cents, rather than dollars. In part, because individual losses tend to be small, and also because they occur in hundreds of thousands of trucks, distribution centers and supermarkets across the nation, it is highly unlikely that losses can be significantly reduced by single or simplistic actions.

There are numerous causes for losses of dairy products. Some of the more important are: lack of adequate temperature control, improper or abusive handling, slow product movement, and inadequate packaging.

Clearly, solutions for reducing a particular loss situation will require a thorough understanding of the specific circumstances surrounding the given loss problem. In many instances solutions will require a combination of changes in the distribution system, however, many loss reducing proposals may begin with the

Table 2. Estimated Ranges of 1977 Dairy Product Losses in the Distribution System[1]

Distribution Activity	Losses[2]	Value of Losses[3]
	(percent)	(millions of dollars)
Transportation[4]	--	--
Wholesaling	.50 - 1.00	57.64 - 118.06
Retailing	.13 - 2.50	14.75 - 294.94
Systems Losses	.63 - 3.50	72.39 - 413.00

[1]Losses cited are estimated values of physical quantities of food lost for human consumption. Costs of recoup, salvage operations and numerous indirect costs associated with losses and damage are not included.

[2]Percentage losses are based upon dollar values of losses in each phase of distribution as a percentage of the wholesale value of products entering the distribution system. Wholesale values of products entering the system are estimated to have ranged from $11,527.55 million to $11,805.68 million. This range accommodates the given loss rates and supermarket dairy product sales of $14,747 million (3).

[3]Losses in wholesaling activities are valued at wholesale prices; and losses at retail are valued at retail prices. The estimated retail gross margin of dairy products is 22.3 percent (3).

[4]Estimates of losses during initial transportation were not available; however, it is believed that losses during the distribution of product at this level are relatively small. It is also likely that some product damage occurring in the transportation phase is subsequently discovered and reported at the wholesaling and retailing levels.

consideration of the following recommendations: (1) use efficient, properly functioning refrigeration equipment, (2) develop programs for the systematic monitoring of product temperatures, (3) reduce the number of handling steps and increase the rate of product movement through the distribution system, (4) maintain proper product rotation and (5) follow a program of well-informed, conscientious product ordering.

It should be emphasized that each of the above considerations for remedies can only be carried out successfully within appropriate organizational climates which must be established by management at all levels of the distribution system. Professional management -- and all that it implies -- is a requisite for successful loss reduction activities.

Over time, important reductions in dairy product losses have resulted from increased vertical coordination in the distribution channels, and the use of improved materials handling and packaging technologies. Vertical coordination has been carried out largely through the integration of operations with resulting efficiencies in handling. It seems clear, however, that motivation other than loss reduction provided the primary impetus for the vetical integration which has taken place. Improvements in handling technology, such as the previously described rear-loaded cases and three-sided wire milk containers, also have reduced handling losses. Once again, it appears that the principal incentive in the development and implementation of such technology has been the labor cost savings, rather than the loss reduction potentials.

It is apparent that further reduction in dairy product losses will occur with periodic improvements in refrigeration, packaging and handling technology. However, it is also likely that the most powerful driving forces behind such technological developments will be the economic need for improved labor efficiency, product safety and overall distributional efficiency, rather than the desire to minimize losses as an all-encompassing goal.

The final portion of this report presents three separate summaries. The first lists major causal factors for dairy product losses occurring during distribution. This list identifies and generalizes the causes for losses at a basic level. The letters in parentheses to the right of each factor in the

summary provide a coding system. The codes are used along with the specific causes for losses which are listed next.

The second summary identifies specific causes for losses in the contexts of the phases and functions of the distribution system. The major causal factor codes indicate the related, underlying causes.

The third summary provides a preliminary list of potential remedies for product loss reductions. It is not intended to indicate that such remedies are either technologically or economically feasible, but only that there are numerous opportunities which warrant careful consideration and analysis, and indeed, this is the initial requisite step in reducing losses and improving the effectiveness of the food distribution system.

Major Causal Factors for Dairy Product Losses

- Temperature (T)
- Handling (H)
- Packaging (P)
- Out-of-Date (O)

Specific Causes for Dairy Product Losses

- During Transportation -- Processor to Wholesaler
  - * Products and trucks not maintained at the proper temperature prior to loading and in transit (T)
  - * Refrigeration units malfunctioning, or improperly operated (T)
  - * Product damaged during loading or unloading (H)
- During Wholesale Operations
  - * Product delayed on unrefrigerated receiving and loading docks (T)
  - * Product damaged during handling (H)
    - -- Receiving or shipping docks
    - -- Movement to storage area

-- Storage

-- Assembly and loading for delivery to supermarkets

* Packaging fails to provide reasonable protection under normal loading, in transit and unloading conditions (P)

-- Containers crushed from stacking

* Multiplicity of secondary container sizes which leads to unstable mixed pallet loads (P)

* Failure to redistribute loads during deliveries (H-P)

- During Supermarket Operations

* Abusive handling during (H)

-- Receiving

-- Movement to backroom or display cases

* Leaking or otherwise damaged containers (P)

* Damaged container contents (P-H)

* Overstocked refrigeration units (T)

* Malfunctioning refrigeration units (T)

* Delays in backroom and at the display case prior to stocking (T)

* Product pulled from shelf because of sales date expiration (O)

-- Improper stock rotation

-- Overordering

-- Unanticipated demand conditions

-- Slow movement of product through distribution system

* Damaged during consumer purchase activities (H)

Remedies for Dairy Product Losses

- Improved Handling and Stock Rotation

* Roll-in carts for the dairy case

* Three-sided wire baskets

- * Vertical coordination of distribution activities
- * Management awareness and training
- * Employee training

- Improved Packaging
  - * Performance rated packaging to accommodate reasonable handling procedures and conditions
  - * Modular secondary containers
- Improved Temperature Control
  - * Properly functioning refrigeration units
  - * Adequate cooling of product and trucks prior to loading
  - * Correct stocking techniques in retail cases
  - * Programmed monitoring of product and equipment temperatures
  - * Systematic equipment analysis
- Improved Ordering
  - * Well-informed, conscientious manual ordering
  - * Computerized ordering systems.

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