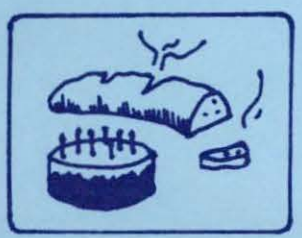
LOSSES IN U.S. FOOD DISTRIBUTION SYSTEM



FROZEN FOOD 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 frozen food distribution through supermarkets; a discussion of the general nature of frozen food losses; and findings of the magnitudes, causes and suggested remedies for frozen food 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
- Dairy Product 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
- Bakery Losses in the U.S. Food Distribution System
- Delicatessen Food Losses in the U.S. Food Distribution System.

FROZEN FOOD 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 pose 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 frozen food losses in the U.S. frozen food system.

The Nature of the Research

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

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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.

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 frozen food available for human consumption. Although different "frozen food 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 frozen food lost for human consumption.

The project covered frozen food distribution activities ranging from the processor's shipping dock through transportation, wholesaling, and supermarket retailing operations. The distribution systems covered in the study were those ending with the supermarket, and most often they began with transportation to distribution centers or warehouses which service supermarkets. In essence, the vast majority of transportation, wholesaling, and supermarket retailing activities of frozen food were included for study.

The specific objectives of the study were:

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

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

-- To identify frozen food 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 synethsis of selected published data was conducted in order to develop a comprehensive picture of frozen 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.

Frozen Food Distribution

The frozen food industry has realized substantial growth since the 1950s. Production has increased by over 800 percent, from 2,036 million pounds in 1950 to 18,698 million pounds in 1974 (9). This outstanding growth of frozen foods can be attributed to many factors: technological advances in the quick-freeze process; improvements in refrigerated transportation and warehouse facilities; as well as improved retailer storage and display equipment; and an expanded variety of products that appeal to consumers (9).

Frozen food products included for study are those which are regularly found in the frozen food section of the supermarket, including: vegetables, fruits, juices, drinks, prepared products, baked goods, meats, fish, and so forth. In 1977, frozen foods, excluding ice cream, accounted for 8.1 percent of supermarket food sales, or about $7.9 billion (3). Table 1 presents recent supermarket frozen food sales and related information.

Typically, frozen products are stored in manufacturer-owned or public frozen food warehouses at or near the processing plant. Some manufacturers, however, use

Table 1. Frozen Foods: 1977 Performance in Supermarkets[1]

	Sales				Profit		Assortment	Margin
	% of Dept. Sales	1977 Dollar Volume (Millions)	1976 Dollar Volume (Millions)	% of Diff.	% of Dept. Gross Profit	Gross Profit Dollars (Millions)	Items/ Brands/ Sizes at Whse.	Avg. Gross Margin (% of (Retail)
PREPARED FROZEN FOODS	29.16	2,300.91	2,183.23	5.39	30.63	671.54	324	29.2
Dinners/Lunches/ Breakfasts	5.55	437.83	497.73	-12.02	5.45	119.53	59	27.3
Entrees	20.81	1,642.37	1,391.38	18.04	22.17	486.14	227	29.6
Meat Pies	1.78	140.56	147.06	- 4.41	1.88	41.18	15	29.3
Other Prepared Frozen Foods	1.02	80.15	147.06	-45.49	1.13	24.69	23	30.8
MEAT UNPREPARED	3.25	256.47	203.62	25.96	1.27	27.96	13	10.9
POULTRY UNPREPARED	8.79	683.82	147.06	371.79	6.07	133.21	70	19.2
SEAFOOD								
UNPREPARED	4.19	330.25	316.74	4.27	4.59	100.57	36	30.5
Fish	2.11	166.42	158.37	5.08	2.33	51.09	19	30.7
Shellfish	2.08	163.83	158.37	3.45	2.26	49.48	17	30.2
SOUPS	0.03	2.31	2.32	- 0.42	0.02	0.52	1	22.4
POTATO & ONION PRODUCTS	4.72	372.44	354.76	4.98	5.25	115.06	40	30.9
French Fried Potatoes	3.16	249.14	226.24	10.12	3.52	77.23	18	31.0
All Other Potatoes	1.22	96.17	101.81	- 5.53	1.35	29.52	16	30.7
Onions	0.34	27.13	26.71	1.57	0.38	8.30	6	30.6
VEGETABLES	14.90	1,176.29	1,052.01	11.81	16.20	357.07	191	30.4
Special	5.09	401.96	305.42	31.61	5.41	118.58	84	29.5
Regular	9.81	774.33	746.59	3.72	10.87	238.49	107	30.8
FRUITS & BERRIES	1.29	102.34	135.75	-24.60	1.34	29.65	13	29.0
Strawberries	0.86	67.82	90.50	-25.05	0.89	19.60	5	28.9
All Other Fruits & Berries	0.43	34.52	45.25	-23.70	0.45	10.04	8	29.1
JUICES & DRINKS	16.55	1,306.98	1,052.66	24.16	16.24	356.13	45	27.2
Orange	13.15	1,038.19	780.53	33.01	12.59	276.16	19	26.6
Grape	0.73	57.95	56.56	2.46	0.73	15.99	5	27.6
Lemon/Lime/ Orangeades	1.58	124.53	147.06	-15.31	1.76	38.60	10	31.0
All Other Juices And Drinks	1.09	86.31	68.51	25.98	1.16	25.38	11	29.4
BAKERY PRODUCTS	11.44	903.57	893.66	1.11	12.24	268.47	165	29.7
Bread & Bread Products	1.38	108.64	90.50	20.04	1.59	34.87	21	32.1
Pies--All Types	3.27	258.93	260.93	- 0.47	3.61	79.23	48	30.6
All Other Bakery Items	6.79	536.00	542.98	- 1.28	7.04	154.37	96	28.8
ALL OTHER FROZEN FOODS	5.68	448.00	418.54	7.04	6.07	133.06	29	29.7
TOTAL	100.00	7,893.38	6,760.35	16.76	100.00	2,193.23	927	27.8

Source: See (3).

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

a regional network of warehouses in which frozen food products are distributed to regional distribution centers remaining under the ownership and control of the manufacturer, generally facilitationg better service to wholesale distribution centers. The majority of frozen foods move through the distribution channels by truck; however, some long distance shipments are made by rail.

A search of industry, government and university published sources revealed that specific information on the amounts and kinds of losses sustained by frozen foods during distribution was limited. A number of industry executives, however, contributed significantly to the data base which underlies this report.

THE GENERAL NATURE AND CAUSES OF FROZEN FOOD LOSSES AND DAMAGE

In each phase of distribution -- transportation, wholesaling, and retailing activities -- the principal cause for losses is the failure to maintain required low temperatures. At present, a national policy for the handling of frozen foods has not been implemented; however, fourteen states have adopted codes establishing a maximum temperature of $0^{o}F.$ for frozens. This standard is generally accepted within the industry, but it has been acknowledged that temperatures above $0^{o}F.$ exist in many phases of distribution. A device recently has been introduced that, when attached to frozen food secondary shipping cartons, will record the time and temperature of products throughout the distribution channels. This temperature device is already in use on some overseas shipments, and it is anticipated that it will be used in the foreseeable future in the domestic industry to monitor frozen food temperatures (7).

Many quality losses of frozen foods are difficult to detect where they occur. Temperature standards may not be maintained at various points in the distribution channels and some of these situations may go unnoticed even when the products are ultimately sold and consumed. These products may or may not have undergone quality

losses when temperature standards were exceeded. It is believed by some in the industry that certain products lose little in terms of quality even if thawed and refrozen several times. But, it should be noted that temperatures up to the thawing point are not necessary to initiate substantial quality deterioration in certain other products. While it appears that sensitivity to inadequate temperatures and the extent of quality loss is likely to vary greatly among products, some experts within the industry still believe that at the final point of sale, many products have lost quality due to improper temperature at some point during the distribution process.

In terms of nutritional losses, storage of products at 0^{o}F. or lower will generally result in excellent retention of overall quality and vitamin content. As temperatures rise, however, easily oxidizable vitamins will be lost. For example, when peas are held at 0^{o}F. for six months they will retain 90 percent of the original Vitamin C. However, when stored at 15^{o}F. for six months, half of the original Vitamin C will be lost. This type of loss varies by product, by nutrient, and with time.

In addition to temperature, other major factors influencing the quality of frozens were length of storage, age of product, and the initial rate of freezing (1). The rate of freezing was affected by the type of packaging employed. Therefore, quality can also be affected by the type of packaging.

One manifestation of quality loss is termed, "gross under-weight". These shortweights at retail were attributed generally to continuous product dehydration that occurs over the shelf life of the product. For example, a 2 percent moisture loss was expected when products were stored at 0^{o}F. for 18 to 24 months. Many packers compensate for this loss by adding an extra 2 percent of product by weight during processing. Cyclic and improper storage temperatures aggravate the dehydration problem (1).

Clearly, temperature maintenance is critical to the preservation of quality in most frozen foods. For this reason many manufacturers, wholesalers and retailers have extensive temperature control programs. However, the enforcement of temperature standards is a systems-wide problem which is, at best, difficult to affect due to the sheer size and complexity of the food distribution system. Effective temperature control requires substantial modern refrigeration equipment always to be in proper working condition in both public and private warehouses and in thousands of trucks and supermarkets across the country. Well-trained and highly motivated personnel in each of the many transportation, wholesaling and retailing functions is another key factor relating to maintaining effective temperature control.

LOSSES DURING TRANSPORTATION OPERATIONS -- MANUFACTURER TO WHOLESALER

Estimates of losses occurring during the transportation phase varied substantially. Calculations based upon the Association of American Railroads (ARR) Freight and Damage Reports and the Interstate Commerce Commission (ICC) Class I Motor Carrier Statistics indicated a relatively low loss rate of about .04 percent of merchandise handled (2,6). On the other hand, several industry experts estimated a loss rate of around 1.0 percent. These figures in turn lead to 1977 wholesale values of losses during transportation ranging from $2.30 million to $58.43 million.

In 1974, claims for damages to frozen foods equaled about 1.7 percent of rail revenues. The main reasons for these claims were: temperature failure, theft, improper handling, and train accidents.

The ICC, Class I Motor Carrier Freight Commodity Statistics also contain information on losses and damages in transit based on claims paid. For the 12-month period, October 1973 through September 1974, $457,690 was the total amount of

frozen food claims under the SIC 2037 -- frozen fruits, or vegetables and prepared meals -- category. Major causes for these claims were: shortage, visible damage, and delay (a category which includes damage due to failure of equipment or facilities), employee error, and other unspecified reasons.

In the process of estimating frozen food losses during transportation, a large Midwestern retailer indicated that 3 to 5 percent of incoming frozen shipments are rejected at the frozen food distribution center. These loads are almost always rejected on the basis of high temperatures, above a range of 6^{o} to 10^{o}F. This particular retail firm maintained a full-time temperature quality-control program for frozen foods. It was noted that the rejection rate varied by season, with higher rejection rates generally occurring during the warm, summer months. It was also apparent that the high rejection rates, 3 to 5 percent, did not lead to equally high tonnage loss rates. Many rejected loads are suspected of either being delivered to wholesalers with less stringent temperature standards; or, in the case of more drastic temperature problems, the product was taken to a blast freezer where temperatures could be brought down to acceptable levels before delivery of the product to another wholesaler. It seemed apparent, however, that even if significant quality losses were occurring and tonnage losses were small, the costs of finding alternative buyers, or unloading and reloading in the case of blast freezing, add substantially to the overall costs of frozen food distribution.

There are several causes for inadequate product temperatures during transit. First, the products may not have been loaded at a sufficiently low temperature. Refrigeration units on most trucks are generally capable of maintaining acceptable temperatures; however, they are not meant to reduce product temperatures while in transit. This is especially true during the warm months. Second, truck refrigeration units may not function properly and may not hold temperatures adequately. In some cases, drivers may shut the refrigeration unit down for a period of time in an

attempt to save fuel. When loads are handstacked, and if the trailer is not ribbed, inadequate air circulation may cuase portions of the load to "warm up". Fortunately, most of today's trailers are ribbed. This is especially important with the growing use of slip sheets. When loads are stacked on slip sheets, poor air circulation can become more of a problem than if pallets are used. Slip sheets, of course, can be used to gain efficiency in handling without the loss of cube and the return problems characteristic of pallets.

LOSSES DURING WHOLESALING OPERATIONS

Wholesaling operations for frozen foods include: (1) transfer from the distribution center receiving dock to the frozen food storage area, (2) freezer storage in floor slots or racks, (3) product selection and assembly of store orders, (4) replenishment of picking slots, (5) stock rotation, (6) loading on refrigerated trailers for delivery to supermarkets, (7) delivery to stores and (8) unloading at the suparmarket dock.

Estimates of frozen product losses during wholesaling activities were relatively small. They ranged from .25 to .50 percent of the wholesale value of frozen product reaching wholesalers' distribution centers. These rates converted to a range of losses from $14.35 million to $28.93 million when valued at 1977 wholesale prices.

Causes for losses in the wholesaling operations varied. Exposure to potential temperature problems occurred primarily during unloading and loading at the distribution center and during delivery to supermarkets. Major problems occurred in unloading and loading operations when products were stacked on the receiving and shipping dock. These dock areas were seldom refrigerated, thus temperatures may have ranged from 75^{o}F. in the summer to 0^{o}F. in the winter. Despite the fact that many firms have strict policies regarding the length of time product may stand on

the loading and unloading areas, losses caused by these operational delays frequently occurred. Temperature problems during delivery to supermarkets arose most frequently due to refrigeration unit failure and delays at store receiving docks. Such delays were avoided by some firms which elected to make night deliveries.

Other problems in wholesaling operations were similar to those encountered in dry grocery distribution. In the distribution center, damage due to improper handling and packaging problems dominated. Causes of handling damage to frozen food products included the following: falling or bumped from the slot, dropped by the selector, stuck in slots by equipment, fell during letdown, fell in slot filling, nails and splinters on pallets, hit in aisles by equipment, and crushed by weight above.

Common packaging problems included: excess air space in secondary containers, which led to crushing; poor labeling, which resulted in misselected items and subsequent exposure to losses; unglued case flaps; and perhaps most importantly, the lack of modularized secondary containers. The absence of modularized shipping containers for some 700 to 1,000 or more items in the frozen food warehouse, made the assembly of stable, mixed pallet loads for store delivery almost impossible. As a result, substantial damage was incurred during loading, in transit and in unloading at supermarkets. In order to process damaged frozen food products, many wholesalers operated frozen food recoup or salvage rooms.

LOSSES DURING SUPERMARKETING OPERATIONS

Tonnage losses of frozen foods during retailing activities were relatively small. As a percentage of retail frozen food sales, losses were estimated to range from about .50 to 1.0 percent. When valued at 1977 retail prices, dollar losses ranged from about $39.47 million to $78.93 million. Retail losses of frozen foods occurred during the following activities: (1) receiving of product at the super-

market dock, (2) storage in a backroom freezer, (3) movement and staging of products prior to stocking in the frozen food display case, and (4) pricing and merchandising of product in the display case.

Several factors were cited as direct contributory causes of frozen food losses in supermarkets. These factors included: Handling delays, equipment breakdown, over-ordering, faulty display stocking practices, abusive handling and packaging problems. Handling delays often are caused by backroom delays, where merchandise which has been unloaded and checked in, remains in the backroom for excessive periods prior to storage in backroom freezers or stocking in retail display cases. A second handling delay, however, may occur at the frozen food display case itself. For example, an entire load of frozen food may be staged next to the display case prior to pricing and stocking instead of doing so on a cart-by-cart basis. In some instances this latter type of delay resulted from pressure for greater labor productivity. A third delay, though often considered to be a wholesaling problem, was the delay of delivery trucks at the supermarket dock. These delays resulted either from dock space occupied by other delivery vehicles or by backroom space being unavailable to accommodate incoming merchandise. Whether this problem is primarily a wholesaling or retailing responsibility, solutions will probably require joint efforts on the part of the management of both industry groups. In all three delay situations causing losses, temperature standards are exceeded.

Temperature problems are also related to supermarket equipment. The most common form of equipment breakdown affecting frozen foods was the breakdown or malfunctioning of frozen food display cases. New and remodeled stores with modern equipment posed especially high risk situations until normal start-up operating difficulties were resolved; or in some instances, until store personnel become acquainted with the equipment and could compensate for operational challenges presented by new or different equipment. The changing of seasons was another

factor affecting frozen display case operation. If refrigeration equipment is located near outside walls, with insufficient insulation, its environment may change with the seasons; consequently, operating characteristics also may change.

Problems of over-ordering and poor display case stocking practices also contributed to temperature problems. Backroom freezer space was usually quite limited, thus over-ordering frequently led to over-filling display cases to the extent that proper air flows and the maintenance of proper temperatures were inhibited. However, over-stocking of the frozens case does not necessarily result from over-ordering. Frequently stock clerks overloaded a case to save time, to avoid the trip to the backroom freezer.

In frozen foods, as in virtually all other product categories, losses were caused by a variety of abusive handling and inadequate packaging practices. Some problems of this kind originated at store level while others occurred in earlier stages of the processing and distribution system and were first discovered at the retail level. Examples included: (1) the cutting of primary contains with case cutters, while in the process of opening secondary cases, (2) crushing fragile merchandize while stacking cases on carts and (3) improperly sealed polybags of frozen products.

Simple solutions to eliminate these problems are not likely to be found. It seems clear, however, that measures can be taken to greatly reduce loss problems. Delivery dock delays can be offset by better retail-wholesale coordination. Equipment problems, especially those that have become chronic, could perhaps be identified and remedied through effective programs of store-level equipment analysis. Greater coordination between the distribution industry and equipment manufacturers appears potentially useful. Other solutions probably will stem from improved backroom and freezer space management, as would improved clerk training programs.

SUMMARY AND CONCLUSIONS

Table 2 presents a summary of estimated frozen food losses during the distributive processes. Dollar and percentage losses are shown for transportation, wholesaling, retailing, and the distribution systems in total. The figures generally represent the value of quantity losses, that portion of frozen product that is lost for human consumption due to damage in the distribution system.

Table 2. Estimated Ranges of 1977 Frozen Food Losses in the Distribution System[1]

Distribution Activity	Losses[2]	Value of Losses[3]
	(percent)	(millions of dollars)
Transportation	.04 - 1.00	2.30 - 58.43
Wholesaling	.25 - .50	14.35 - 28.93
Retailing	.69 - 1.35	39.47 - 78.93
Systems Losses	.98 - 2.85	56.12 - 166.29

[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 $5,744.17 million to $5,843.36 million. This range accommodates the given loss rates and supermarket frozen food sales of $7,893.38 million (3).

[3]Losses in transportation and wholesaling activities are valued at wholesale prices and losses at retail are valued at retail prices. The retail gross margin is 27.8 percent (3).

It is important to note several limitations of these estimates. First, the ranges of losses are extremely broad. These ranges reflect substantial variations in practice and performance being achieved by firms in the frozen food distribution system. Also, substantive information pertaining to losses of frozens is extremely

fragmented. In this sense, the wide ranges reflect substantial uncertainty concerning a "normal" range of losses. Thus, average losses cannot be assumed to exist at the midpoint of each range.

Another aspect of the data deserves comment. Aggregate U.S. frozen food losses appear to be very large. This should not lead to the conclusion that significant loss reductions can be easily achieved. Unlike the aggregate figures in millions of dollars, individual loss incidents are relatively small in size and value. Furthermore, they occur in hundreds of thousands of trailers, distribution centers and supermarkets. Thus, reducing losses will require innovative, broad-based changes in the distribution system.

In addition to frozen food quantity losses -- losses in product mass -- frozen foods also suffer quality losses. Such subtle losses often go undiscovered in the distribution system itself. Even in the homes of consumers, it is likely that minor quality losses go largely undetected. But, certainly in many instances consumers realize when they have purchased an inferior quality product, even though they may not be able to identify its precise cause. They simply realize it is less than satisfactory. Such situations pose both short-term and long-term problems for the frozen food and related industries. Affected firms include growers of raw agricultural commodities, frozen food processors and manufacturers, wholesalers, and retailers since the success of each of these groups ultimately depends upon satisfied consumers. It seems likely that progress toward the reduction of both quantity and quality losses in frozen foods would be facilitated if the unmeasured costs of quality losses could be combined with more obviously determined costs of quantity losses. This broader view of the costs of losses would provide greater economic incentives for loss reduction efforts.

In terms of specific problems, the necessity to maintain temperature standards looms as the most significant factor with respect to frozen food losses.

However, as has been indicated, there are many distinct problem areas that must be dealt with on a coordinated, systems-wide basis in order to substantially improve temperature control. Management systems must be developed to monitor temperatures at each phase in the distribution processes, analyze problem areas and implement improvements.

The final portion of this report presents three summaries. The first lists major causal factors for frozen food 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 Frozen Food Losses

- Temperature (T)
- Handling (H)
- Packaging (P)

Specific Causes for Frozen Food Losses

- During Transportation -- Manufacturer to Wholesaler
  - * Malfunction or improper operation of truck and rail car refrigeration units (T)

* Product or truck is not at the proper temperature prior to loading and transit (T)

* Product is stacked in a manner inhibiting proper air circulation (T)

* Product is damaged during loading or unloading (H)

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

- During Wholesale Operations

  * Delays on unrefrigerated receiving and shipping docks (T)

  * Product damaged in handling (H)

    -- Receiving and shipping docks

    -- Movement to frozen food storage area

    -- Storage

    -- Assembly and loading for shipment to supermarkets

  * Malfunction of refrigeration unit on delivery trucks (T)

  * Delay of delivery trucks at supermarkets during or prior to unloading (T)

  * Inadequately labeled packages which increase the potential for losses (P)

  * Packaging does not provide reasonable protection under normal handling and storage conditions (P)

    -- Excessive air space in secondary containers

    -- Package lacks integral strength

    -- Package flaps unglued or insufficiently taped

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

- During Supermarket Operations

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

  * Product damaged during (H)

    -- Unloading of delivery trucks

    -- Handstacking on stocking carts

-- Movement to the backroom freezer and the display case

-- Use of case cutters to open secondary containers

-- Pricing and stocking in the display case

* Display case breakdown (T)

* Over-ordering and poor stocking practices (T)

* Improper seals on poly-bagged merchandise (P)

Remedies for Frozen Food Losses

- Improve Temperature Control Systems

  * Initiate systems for temperature monitoring throughout distribution activities

  * Institute programs for regular transportation and supermarket equipment analysis and maintenance

  * Improve wholesale-retail coordination for delivery to supermarkets

  * Develop improved supermarket ordering systems, policies, and practices

  * Monitor maximum time standards for product handling in unrefrigerated areas

- Improve Handling Practices

  * Improve handling policies and practices at the distribution center and at the supermarket

  * Improve management awareness and training

  * Improve employee training

- Improve Packaging

  * Initiate the development of a performance rating system for packaging

  * Initiate a program for the development of modular secondary containers

Appendix I

American Association of Railroads Comparison of Claims: Frozen Poultry
(dollars)

Year	Total	Loss Entire Package	Loss Other Than Entire Package	Improper Handling	Defective Equip.	Temp. Failure	Delay	Theft	Concealed Damage	Train Accident	Fire	Error of Employee
1966	48,544	9,599	1,837	5,632	567	25,389	4,693	785	3	--	--	39
1967	62,758	5,138	675	9,854	17,231	25,910	712	1,864	47	1,327	--	--
1968	110,415	8,820	1,443	8,424	22,986	61,275	1,242	5,899	21	167	--	141
1969	141,252	12,293	5,152	46,566	745	68,595	817	3,325	802	2,549	--	408
1970	105,400	19,905	7,227	7,275	1,449	26,196	28,461	13,073	--	1,814	--	--
1971	216,200	28,451	3,058	28,966	598	95,062	3,269	23,407	194	32,369	--	826
1972	116,859	27,550	1,313	11,707	1,270	27,782	88	34,716	--	12,433	--	--
1973	115,719	18,383	1,134	5,393	9,168	54,173	328	26,651	13	401	--	75
1974	137,619	15,200	773	9,267	11,443	35,437	4,816	57,020	--	3,447	216	--
1975	102,280	15,092	1,558	23,545	2,611	5,817	--	45,658	--	4,000	354	3,645

Source: See (2)

Appendix II

American Association of Railroads Comparion of Claims: Frozen Fruits and Vegetables
(dollars)

Year	Total	Loss Entire Package	Loss Other Than Entire Package	Improper Handling	Defective Equip.	Temp. Failure	Delay	Theft	Concealed Damage	Train Accident	Fire	Error of Employee
1966	617,031	17,344	1,862	229,178	24,870	239,042	5,315	5,384	1,539	83,490	--	9,007
1967	576,754	11,629	11,348	264,136	20,121	205,702	263	915	6,749	44,363	679	10,844
1968	800,290	25,930	9,338	256,615	15,027	327,776	4,456	7,784	12,940	118,381	--	22,043
1969	957,053	23,576	6,301	271,241	30,714	320,820	1,097	6,100	6,057	283,700	119	7,328
1970	874,774	34,876	14,313	158,143	8,314	484,151	547	27,156	356	129,634	--	17,284
1971	1,333,420	49,994	4,539	253,090	3,175	807,460	8,493	43,579	178	105,831	17,033	40,048
1972	1,227,752	47,836	8,258	273,209	9,001	662,600	4,545	57,513	182	143,392	14	21,202
1973	1,244,162	27,788	3,529	231,422	3,653	811,003	3,128	50,234	--	104,491	5,374	3,540
1974	1,397,101	32,708	11,461	227,763	15,319	851,848	11,630	81,914	36	154,370	--	10,052
1975	2,056,799	39,587	7,130	306,558	38,005	1,047,022	19,513	113,616	2,607	443,928	23,341	15,492

Source: See (2)

Appendix III

Association of American Railroads Comparison of Claims: Frozen Meat

Year	Total	Loss Entire Package	Loss Other Than Entire Package	Improper Handling	Defective Equip.	Temp. Failure	Delay	Theft	Concealed Damage	Train Accident	Fire	Error of Employee
1966	157,311	23,788	1,677	--	11,417	85,712	7,617	2,705	72	24,224	--	99
1967	329,803	11,076	3,424	34,289	27,949	177,826	8,013	1,217	349	61,872	3,663	125
1968	336,360	19,453	1,077	53,788	2,680	96,634	35,282	11,801	274	52,281	4,101	58,989
1969	398,128	15,250	6,138	50,049	586	186,329	3,942	6,590	2,162	120,175	--	6,907
1970	457,391	51,579	6,279	19,422	727	293,251	5,339	21,413	20	47,722	--	11,639
1971	451,071	51,934	5,304	47,345	1,011	244,786	32,615	50,901	--	5,407	--	11,768
1972	359,127	28,877	2,911	78,747	11,206	145,129	13,581	64,149	--	14,527	--	--
1973	468,051	21,625	3,932	--	29,117	250,981	4,072	77,535	--	80,022	--	767
1974	411,317	20,461	5,339	9,104	--	125,316	9,465	142,860	531	94,396	--	3,845
1975	470,429	23,545	7,318	26,472	751	181,496	34,811	158,099	--	37,821	--	116

Source: See (2).

Appendix IV

Association of American Railroads Loss and Damage (L & D)

Year	Carload L&D	No. of Cars Originated	Freight Revenue	L&D Per Car	L&D Per $100 Revenue
			Frozen Fruits & Vegetables		
1966	611,311	53,456	51,355,176	11.44	1.19
1967	564,795	58,556	56,191,526	9.65	1.00
1968	780,737	62,007	61,988,012	12.58	1.26
1969	940,119	63,684	67,341,340	14.76	1.40
1970	858,930	67,447	77,444,865	12.73	1.11
1971	1,309,773	68,002	86,615,210	19.26	1.51
1972	1,197,150	61,142	84,531,207	19.58	1.42
1973	1,211,883	61,783	89,699,000	19.62	1.35
1974	1,341,705	61,632	101,995,000	21.77	1.32
			Frozen Meat		
1966	138,936	10,845	6,276,272	12.81	2.21
1967	325,393	14,351	9,478,528	22.67	3.43
1968	329,606	13,883	9,874,235	23.74	3.34
1969	391,342	13,556	10,839,633	28.87	3.61
1970	448,115	10,528	9,316,046	42.56	4.81
1971	432,461	9,841	10,277,139	43.94	4.21
1972	346,812	8,656	9,328,497	40.07	3.72
1973	441,927	6,817	7,606,000	64.83	5.81
1974	395,827	6,584	8,585,000	60.12	4.61
			Frozen Poultry		
1966	40,962	5,515	3,945,423	7.43	1.04
1967	61,042	6,374	4,451,895	9.58	1.37
1968	105,286	5,745	4,228,500	18.33	2.49
1969	131,762	4,681	3,904,431	28.15	3.37
1970	95,157	4,206	4,054,485	22.62	2.35
1971	212,514	4,329	4,383,380	49.09	4.85
1972	94,289	3,685	3,666,977	25.59	2.57
1973	105,820	3,413	3,375,000	31.00	3.14
1974	120,166	2,938	3,436,000	40.90	3.50

Source: See (2).

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