AN INQUIRY INTO THE CENTRALIZED PREPACKAGING OF PRODUCE

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CHAPTER I

INTRODUCTION

Purpose of the Study

It is the purpose of this study; (1) to present a short history of the development of prepackaging, and then to discuss the industry as it stands today - the commodities packaged, requirements for successful packaging, types of handlers engaged in prepackaging, and methods of procuring, packaging and selling the merchandise; (2) to cite some facts showing why prepackaging is important in our present day economy; (3) to set forth some of the problems that are facing the prepackaging industry, and the important questions that need answering; (4) to indicate the types of packages and films being used for prepackaging produce, and the desirable qualities of each; (5) to point out the types of equipment and layouts being used, with an outline approach to better handling and prepackaging methods, some of the technological aspects involved, such as methods of refrigeration, germicidal treatment, and food plant sanitation; and (6) to summarize several of the cost studies that have been made so that one can get some idea of the relative costs involved in prepackaging and handling as contrasted with the conventional bulk methods of merchandising.

Importance of the Study

Prepackaging is not something that is dead and buried; it is very much alive and will be for some time to come. It is a subject that concerns all of us, because if we are not directly connected with the prepackaging industry in some way, it is certain that we are all consumers

and as such are interested in ways of improving our standard of living. By reducing or eliminating wastes, introducing short cuts and savings, and bringing the consumer fresh fruits and vegetables in vine-ripened or tree-ripened stages maintained at the optimum degree of succulence and palatability, prepackaging does just that.

The industry is growing fast. The expansion and growth of self-service, development of refrigerated display cases, high retail operating costs and mass, high-volume methods of merchandising have made the advent of prepackaging a certainty. Only time is necessary before the shift to prepackaging of other produce items becomes as apparent as it now is in California oranges, for example.

The amount of fruit and vegetables prepackaged by the industry in 1950 totaled more than three and one-third billion pounds. It took 12 million pounds of flexible, transparent film, 50 million pounds of paperboard, 201 million mesh bags, and 17 million paper mesh-window bags to do this tremendous prepackaging job.[1]

While much has been written on the subject of prepackaging in the past several years, so far as is known, no one has incorporated the total content of this study into a single unit. In order to find out anything about the subject, it is necessary to look for the information in articles scattered throughout various publications. If the desired data are not found, the next step would probably be to write to someone who might be able to supply these data.

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1 Earl French, Review Past and Examine Future of Prepackaging in Opening Session of Columbus Conference, Pre-Pack-Age, April, 1951, p. 16.

It is hoped that this work will present, to anyone interested, a relatively complete picture of the prepackaging industry as it stands today. It would be impossible, of course, to cover every detail in a work of this kind; but the attempt has been made to highlight the main considerations in a clear, concise manner.

Definition

"Prepackaging" has some descriptive weaknesses, but it is now accepted as identifying the process by which such products as fresh fruits, vegetables and meats are prepared for self-service in the retail store. This process is two-fold; (1) it subjects the produce to whatever sorting, washing and trimming may be necessary to prepare it partly or completely for kitchen or table use, and (2) transforms it, either with or without precooling and refrigeration, into self-service items by packaging in prepriced, labeled, and closed containers - each holding a customary consumer unit.[1]

Sources of Data

The data for this thesis were obtained primarily from periodical articles, with a very small part being derived from books. Also, a great deal of helpful information was procurred through correspondence with men who are well versed in the implications of this field. In addition, these men along with various manufacturing concerns, magazine publishers, the Department of Agriculture, the State Agricultural Experiment Stations and Agricultural Colleges supplied many pamphlets and bulletins which proved to be very important in this writing.

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1 Charles W. Hauck, Prepackaging - A New Industry in the Making. Pre-Pack-Age. September, 1947, p. 7.

CHAPTER II

HISTORY AND PRESENT STATUS

History

Prepackaging of fresh produce has gradually evolved into the prominent position that it now occupies. Many people think that the "Columbus, Ohio experiment" was the beginning of this industry, but there had been a great deal of groundwork prior to that experiment.

The operation in Columbus was a joint undertaking of the Great Atlantic and Pacific Tea Company and the Ohio State University Agricultural Experiment Station, starting in 1942 and continuing through 1947. The work that was done there attracted much attention and stimulated active interest in prepackaging to a greater degree than anything that had occurred in the past. It also provided some needed facts under actual retail conditions. However, some pioneering had been under way as far back as 20 or 25 years before 1942, the year in which the Columbus project was begun.

Some of this early experimentation was fundamental research conducted by experiment stations and other agencies, dealing with the nature of different wrapping materials and their effect upon plant and animal tissues when sealed in these wrappers. For example, in 1928, Mr. H. D. Brown described a series of tests on the effects of various papers upon the quality of certain fruits and vegetables in Michigan Agricultural Experiment Station Technical Bulletin 87. Stahl and Vaughan published one of the earliest official accounts of experimental work in this field in Florida Experiment Station Bulletin 369 in 1942, under the title, "Pliofilm

in the Preservation of Florida Fruits and Vegetables." Since that date the literature on prepackaging has become more prevalent.

At the same time a number of commercial trials were being conducted here and there. Mushrooms in consumer-size paperboard boxes have been on the market since the late 1920's, and brussels sprouts since the mid-30's. Spinach and tomatoes have been prepackaged since the late 1930's, and growing in popularity ever since. Prepackaging of citrus fruits got its start in Florida about 1932, and at the present time there is large volume packaging of these fruits at both growing-shipping[1] and terminal market levels. Also, paper and mesh consumer units of potatoes and dry onions have been on the market for some time.

In 1932 Mr. J. D. Rankin, of du Pont's Cellophane Division, interested the Sanitary Grocery Company in Washington, D. C. (now Safeway Stores) in an organized approach to produce prepackaging. At the same time the du Pont Company collaborated in some extensive trial packaging of various produce items in Florida, including sweet corn, which was shipped to outlets in Philadelphia, and lemons shipped to Minneapolis and St. Paul, Minnesota.

Growers and shippers were not ready for prepackaging at the points of origin; so in 1934 Rankin brought his trials closer to the consumer by joining with Mr. Mike Freeman, who became president of the Freeman Produce Company, in New York City. They developed a prepackaging operation to supply some retail chains. Lettuce packing had to be discontinued because bidding on packageable quality in the New York produce market made prices

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1 The growing-shipping level refers to the shipping point. The grower-shipper grows as well as ships his own produce; while the grower himself usually has no facilities for crating and shipping, but generally contracts with the grower-shipper to find a market for his products.

prohibitive, but the Freeman Produce Company continued consumer packaging of brussels sprouts and is now one of the largest packagers of that product in the country.

In 1933-34 Louis Marx, a cooperative grocer in Wolcott, New York packaged celery in a cellophane wrapper. This worked well, and was later used in Florida with success and then by Harry Becker, president of Harry Becker and Company, in Detroit in 1937.

In 1935 First National Stores started to prepackage produce centrally in order to supply their Boston stores, and then extended the operation to Hartford and White Plains, New York. Inasmuch as none of the stores had yet moved very far in the direction of self-service, they were not ready for it in the produce departments.

About 1935, onions and potatoes in five, ten, and fifteen pound units came into prominence. Large quantities of Idaho potatoes were packed in that year, followed by the "Super Spuds" program in Maine in 1937, which further increased the use of consumer packages for potatoes.

The pioneering of such organizations as Farmer Brown in Springfield, Massachusetts, Sunny Sally in Los Angeles, the Crosset Brothers in Cincinnati, Art Romp, Cavalier, Gulling and Wilson in Cleveland, Aunt Mid in Chicago, Lee Duvall in Baltimore and many others cannot be overlooked. They had to proceed by trial and error, but gradually learned how to do the job. They did much to get the public acquainted with prepackaging, as well as to build up acceptance for it.

With the advent of the war in the early 1940's, prepackaging slowed down considerably because of the shortage of packaging materials. In spite of this, the Atlantic and Pacific Tea Company carried on its experi-

mental project in Columbus, Ohio; and the American Stores Company carried on a similar experiment in Kearny, New Jersey. Also, the citrus industry packaged a great deal of its fruit in mesh bags during the war.

Interest and activity increased rapidly in the middle and late 1940's. Central packing in receiving markets grew and reached large proportions. Tomato repacking, which had been done by hand, became a large scale operation in many cities with the introduction of automatic overwrapping equipment. Paul Dickman in Florida, Willard Farnsworth and Dennis Tope in Ohio, and other grower-shippers elsewhere came into prominence as suppliers of prepacked produce. Special packaging companies sprang up in many markets. Manufacturers, in turn, developed better packing materials and supplies, needed machinery and equipment. Retailers installed more and more refrigerated self-service display and sales cases.

In 1947, the Western Growers Association, with Mr. A. L. Martin as director of research, climaxed experiments of several years on produce handling by shipping several carlot shipments of prepackaged vegetables from California to eastern markets. The Florida Vegetable Prepackaging Council also came into existence in 1947, and at the present time has a continuing experimental program going in cooperation with the University of Florida and the United States Department of Agriculture.

In 1946, the passage of the Research and Marketing Act stimulated research in consumer packaging. Economic and technological studies have been made by several of the State Agricultural Experiment Stations and the United States Department of Agriculture, while others are now in process.

In September, 1947, a monthly periodical, Pre-Pack-Age, was started to deal exclusively with prepackaging matters.

National meetings were held in 1948 and 1949 in conjunction with the National League of Wholesale Fresh Fruit and Vegetable Distributors, and in 1949, with the Packaging Institute. Prepackagers and related commercial interests, research workers, and others exchanged views and experiences with the end result being the foundation of the Produce Prepackaging Association. This organization is now furnishing leadership and is the official spokesman for the industry.

It can be said that the pioneering stage is just about over and the prepackaging industry is starting to grow. Of course, there is still much to be learned, but the essential groundwork has been laid and it is apparent that the story will continue to unfold for a long time to come.[1]

Present Status

Commodities packaged. Nearly all fruits and vegetables have been sold in consumer packages, although usually on a small scale. It is still not possible to obtain all items in every part of the country.

The most commonly available prepackaged item is tomatoes, of which about one billion consumer units are sold in the United States annually. Prepackagers supply this product to retailers in every major metropolitan area in the country. General line vegetables, such as spinach, kale, salad mix, soup mix, cole slaw, et cetera, are also usually available except in extremely hot weather during the summer months.

Lettuce has been packaged on an experimental basis for some time, and with the recent development of automatic equipment it is expected that it will soon be prepackaged commercially in many large population centers.

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1 Charles W. Hauck, History and Background. Pre-Pack-Age. August, 1950, pp. 15-17.

Packaged celery is also becoming more and more popular. This has been a popular item in California and some parts of New England, but with increased production and distribution facilities, this vegetable product is now being supplied rather generally.

Sweet corn in consumer units has definitely passed the experimental stage, and is being packaged in volume both in the growing areas and at local distribution points. Brussels sprouts is a long-time prepackaged favorite that has been generally available. Gradually coming out of the experimental packaging stage are such items as asparagus, broccoli and cauliflower, and they should soon be available in some volume.

The important hard items being prepackaged are potatoes and onions. Principal packers are located in the growing areas, but many distribution point operations are also scattered throughout the country.

Of the fruit items, those available in any quantity include apples, cranberries and citrus fruits. Cranberries are particularly abundant in prepackaged form, with about 75 percent of the fresh crop being distributed in this manner.

Peaches, pears and plums have been packaged experimentally and in some volume, and indications are that they will soon be commercially available. Cherries have been shipped to large population centers in packaged form from California and Washington, and probably will be available in substantial volume in the near future.

Following is a list of fruit and vegetable items which are now available in packaged form, or which have been successfully prepackaged experimentally and should soon be available:[1]

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1 Editors, United States Department of Agriculture, and the Produce Prepackaging Association. Items Prepackaged in Quantity. Pre-Pack-Age. August, 1950, p. 20.

Fruits		Vegetables	
Apples	Nectarines	Artichokes	Mushrooms
Cherries	Oranges	Asparagus	Onions and garlic
Cranberries	Peaches	Broccoli	Potatoes
Grapes	Pears	Brussels sprouts	Salad mix and slaw
Lemons	Plums	Carrots	Spinach and kale
Limes		Cauliflower	Sweet corn
		Celery	Tomatoes
		Lettuce	

Requirements for successful packaging. Tables 1 and 2 summarize the relative importance of the principal vegetables and fruits as measured by production, the sources of production, trends in consumption and factors affecting their prospects for prepackaging.

The general trend in per capita consumption of fresh vegetables is up, but a few items had a lower average consumption during the five-year period from 1944 through 1948 than in the previous 20 years. Vegetables of which consumption has decreased are cantaloups, potatoes, spinach, and sweet potatoes.

The factors which are important in determining the relative possibilities for prepackaging the various vegetables and fruits, as shown in the tables, are:

1. Need for unitizing loose items; that is, for packaging or bagging small products such as onions, potatoes, peaches.
2. Possibilities for reduction of waste and spoilage.
3. Need for preparation or kitchen servicing by the prepacker.
4. Relative costs of prepackaging and bulk packaging.
5. The effect of prepackaging on preservation of quality.

There are other factors which are important, such as the availability of satisfactory machinery and equipment, unit value and the relative sala-

Table 1.--Comparative production and trend in per capita consumption of fresh vegetables and evaluation of factors affecting their prepackaging potential

Commodity	Average production for the fresh market 1946-47		Rank by weight	States leading in production for fresh market in 1946-47 1/		Average per capita consumption 1924-44 2/	Average per capita consumption 1944-48 2/	Change in consumption	Need for unitising loose commodities 3/	Average percentage waste at retail level 4/		Need for preparation or kitchen servicing by preparers 3/	Prepackage costs in relation to bulk package 3/	Effect of prepackaging on preservation of quality		Prepackaging potential 3/	Estimated package life 3/	Relative concentration of production	Point to prepackage 3/
	Unit	Number	Number	Leading states	Percent of total production	Pounds	Pounds			Bulk	Prepackaged			Moisture retention	Reduce bruising		No. days		
Artichokes	Box	730,000	22	Calif.	100	.1	.2	Up	Yes	9.7	-	No	High	No	No	Poor	1-3	High	-
Asparagus	Crate	4,261,000	17	Calif.; N. J.	87	1.2	1.4	Up	Yes	5.8	-	No	High	Yes	Yes	Good	3-5	High	Source
Beans, lima	Bushel	1,519,000	19	N. Y.; Fla.	63	.7	1.0	Up	Yes	22.0	1.4	Yes	High	Yes	No	Fair	3-5	High	Terminal
Beans, snap	Bushel	17,944,000	10	Fla.; N. Y.	58	7.5	9.0	Up	Yes	4.2	.9	No	High	Yes	No	Good	3-5	High	Terminal-source
Beets	Bushel	2,095,000	18	Tex.; Pa.	88	3.8	4.0	Up	Yes	19.2	-	No	High	Yes	No	Poor	3-5	High	-
Broccoli	Carload	1,800	-	Calif.;Tex.;N.Y.;Fla.	?	?	?	?	Yes	7.5	-	Yes	High	Yes	No	Good	Over 5	Medium	Source
Cabbage	Ton	1,268,000	2	Tex.; Fla.	40	30.5	33.4	Up	No	4.6	-	No	High	Yes	No	Poor	Over 5	Low	-
Cantaloups	Crate	13,230,000	9	Calif.; Ariz.	66	9.3	9.1	Down	No	15.8	-	No	High	No	No	Poor	Over 5	High	-
Carrots	Bushel	22,869,000	8	Calif.; Tex.; Ariz.	65	9.2	11.8	Up	Yes	4.0	6.2	No	High	Yes	No	Fair	Over 5	High	Source
Cauliflower	Crate	12,063,000	11	Calif.; N. Y.	59	2.4	3.3	Up	No	11.8	-	Yes	High	Yes	Yes	Fair	Over 5	High	Source
Celery	Crate	21,712,000	7	Calif.; Fla.; Mich.	76	8.1	10.0	Up	No	5.2	-	No	High	Yes	Yes	Fair	Over 5	High	Terminal-source
Corn (sweet)	Ear	322,690,000	14	N.Y.; N.J.; Pa. (data on other states not available)	100	12.3	12.4	Up	Yes	14.4	1.1	Yes	High	Yes	Yes	Good	3-5	High	Terminal-source
Cucumbers	Bushel	6,619,000	12	Fla.; N.Y.; S.C.; N. J.; Cal.	56	3.3	3.7	Up	No	10.6	-	No	High	Yes	No	Poor	Over 5	Medium	-
Eggplant	Bushel	1,447,000	20	Fla.; N.J.; Tex.; La.	100	.3	.4	Up	No	12.2	-	No	High	No	No	Poor	-	High	-
Kale	Bushel	629,000	23	Va.; S. C.	100	.2	.2	Same	Yes	4.5	3.7	Yes	High	Yes	No	Good	3-5	High	Terminal
Lettuce	Crate	34,027,000	3	Calif.; Ariz.; Fla.	93.5	(12.7	(17.3	(Up	No	7.4	3.1	No	High	Yes	Yes	Fair	3-5	High	Terminal
Escarole	Bushel	1,171,000	21	)	100	(-	(-	(-	No	21.2	-	No	High	Yes	No	Poor	3-5	High	Terminal
Onions	Sack	43,778,000	4	Colo.; N.Y.; Calif.; Mich.	53	18.2	21.3	Up	Yes	6.0	-	No	Medium	No	No	Good	Over 5	Low	Source
Peas	Bushel	4,824,000	16	Calif.; Colo.	50	4.1	4.1	Same	Yes	6.1	1.9	Yes	High	Yes	No	Fair	3-5	High	Terminal
Peppers	Bushel	6,733,000	15	Fla.; N. J.; Calif.	82	2.0	2.2	Up	Yes	13.9	1.5	No	High	No	No	Fair	3-5	High	Terminal
Potatoes	Bushel	348,053,000	1	Maine; Idaho; Calif.; Colo.; N. J.	46	127.9	113.8	Down	Yes	.9	-	Yes	Medium	Yes	No	Good	Over 5	Low	Source
Potatoes (sweet)	Bushel	26,721,000	6	La.; N. C.; Ga.; S. C.; Ala.	54	18.1	14.8	Down	Yes	9.9	-	No	High	No	No	Fair	3-5	Medium	Terminal
Spinach	Bushel	12,953,000	13	Tex.; Calif.; Va.; N. Y.; Pa.	69	3.3	2.9	Down	Yes	8.8	4.0	Yes	High	Yes	No	Good	3-5	Medium	Terminal
Tomatoes	Bushel	31,529,000	5	Tex.; Calif.; Fla. N.J.; N. Y.	63	20.1	23.7	Up	Yes	5.7	4.8	No	High	No	Yes	Good	3-5	Medium	Terminal

1/ Agricultural Statistics, 1948, U.S.D.A.

2/ Miscellaneous Publication No. 691, Consumption of Food in the U. S. All other minor vegetables have a total average per capita consumption of about 20 pounds (excluding watermelons).

3/ Estimated by the author.

4/ The sources of these data are the following publications: "Waste and Spoilage Losses in Merchandising Fresh Fruits and Vegetables in Bulk in Self-Service Food Stores," U.S.D.A., August 1949; "Retailing Prepackaged Fresh Produce by Self-Service Food Stores," U.S.D.A., April-May 1948; "Marketing Florida Prepackaged Sweet Corn," U.S.D.A. and Florida Agricultural Experiment Station, April 1949; and "Marketing Terminal Point Prepackaged Spinach and Kale" (unpublished), U.S.D.A. and Maryland Agricultural Experiment Station.

Prepared by Donald R. Stokes, Production and Marketing Administration, U. S. Department of Agriculture - October 1949.

Table 2.--Comparative production and trend in per capita consumption of fresh fruits and evaluation of factors affecting their prepackaging potential

Commodity	Average production for the fresh market 1940-47 1/		Rank by weight	States leading in production for fresh market in 1946-47 1/		Average per capita consumption 1924-44 2/	Average per capita consumption 1944-48 2/	Change in consumption	Need for unitising loose commodities 3/	Average percentage waste at retail level 4/		Need for preparation or kitchen servicing by packers 3/	Prepackage costs in relation to bulk package 3/	Effect of prepackaging on preservation of quality		Prepackaging potential 3/	Estimated package life 3/	Relative concentration of production	Point to prepackage 3/
	Unit	Number	Number	Leading states	Percent of total production	Pounds	Pounds			Bulk	Prepackaged			Moisture retention	Reduce bruising		No. days		
Apples	Bushel	76,492,000	3	Wash.; N. Y.; Calif.; New England; Mich.	58	38.7	30.2	Down	Yes	4.7	5.4	No	Medium	Yes	Yes	Good	Over 5	Medium	Source
Apricots	Ton	44,215	14	Calif.; Wash.; Utah	100	.4	.6	Up	Yes	21.3	5.3	No	Medium	Yes	Yes	Good	Over 5	High	Source-terminal
Avocados	Ton	12,250	17	Calif.; Fla.	100	.1	.3	Up	No	15.1	-	No	Medium	Yes	Yes	Fair	Over 5	High	Source
Bananas	Bunch	57,019,000	4	Hawaii; P. R.	100	19.4	18.8	Down	Yes	7.6	-	No	-	-	-	-	-	-	-
Cherries	Ton	46,725	13	Wash.; Calif.; Mich.; Ore.; N. Y.	81	1.2	1.0	Down	Yes	16.9	-	No	Low	Yes	Yes	Good	Over 5	High	Source-terminal
Cranberries	Barrel	282,000	16	Mass.; Wisc.; N. J.; Wash.; Ore.	100	.4	.2	Down	Yes	-	-	No	Medium	Yes	No	Good	Over 5	High	Source
Grapefruit	Box	60,575,000	2	Fla.; Tex.; Calif.; Ariz.	100	8.5	12.6	Up	No	6.1	-	No	High	Yes	No	Poor	Over 5	High	Source
Grapes	Ton	609,400	6	Calif.; Mich.; N.Y.; Ohio; Wash.	98	6.8	5.4	Down	Yes	5.6	4.2	No	Medium	Yes	Yes	Fair	3-5	High	Terminal-source
Lemons	Box	13,335,000	7	Calif.	100	3.7	4.6	Up	Yes	3.6	1.7	No	Medium	Yes	No	Good	Over 5	High	Source
Limes	Box	170,000	18	Fla.	100	.1	.1	Same	Yes	7.5	2.2	No	Medium	Yes	No	Good	Over 5	High	Source
Oranges	Box	112,110,000	1	Fla.; Calif.; Tex.; Ariz.; La.	100	27.2	39.2	Up	Yes	3.7	-	No	Medium	Yes	No	Good	Over 5	High	Source
Peaches	Bushel	44,242,000	5	Calif.; S. C.; Ga.; Mich.; Wash.	46	12.1	15.2	Up	Yes	5.6	1.7	No	High	Yes	Yes	Fair	1-3	Low	Terminal
Pears	Bushel	18,385,000	8	Calif.; Ore.; Wash.	78	5.7	6.2	Up	Yes	5.6	1.1	No	High	Yes	Yes	Good	Over 5	High	Source
Pineapples	Box	557,000	15	P.R.; Hawaii; Fla.	100	.7	.8	Up	No	17.1	-	No	High	No	No	Poor	3-5	High	-
Plums	Ton	85,085	11	Calif.; Mich.	100	(			Yes	3.9	2.1	No	Medium	Yes	Yes	Fair	3-5	High	Terminal-source
Prunes	Ton	70,620	12	Idaho; Ore.; Wash.	100	(2.5	2.8	Up	Yes	2.1	.6	No	Medium	Yes	Yes	Fair	3-5	High	Terminal-source
Tangerines	Box	4,350,000	10	Fla.	100	1.2	2.1	Up	Yes	17.6	-	No	Medium	Yes	No	Fair	Over 5	High	Source-terminal
Strawberries	Crate	7,915,500	9	Ore.; La.; Tenn.; Mich.; Calif.	58	3.5	1.7	Down	Yes	28.0	-	No	Medium	?	Yes	Fair	1-3	Medium	Terminal

1/ Agricultural Statistics, 1948.

2/ U.S.D.A. Miscellaneous Publication No. 691 - "Consumption of Food in the United States."

3/ Estimated by the author.

4/ Statistical Supplement to "Waste and Spoilage Losses in Merchandising Fresh Fruits and Vegetables in Bulk in Self-Service Food Stores," U.S.D.A., August 1947.

Prepared by Donald R. Stokes, Production and Marketing Administration, U. S. Department of Agriculture - October 1949.

bility of prepackaged and bulk produce, but the points that are listed are basic in the determination of prepackaging prospects.

The first factor, "Need for unitizing loose items," is important because these loose items have to be bagged sometime before they are taken home by the consumer; and the more economical place to prepackage them is at some concentration point rather than having thousands of retail clerks do the job in the retail stores.

The second factor, "Possibilities for reduction in waste and spoilage," is also very important. Practically all vegetables offer considerable promise for reduction in waste and spoilage losses as well as reduction of labor costs; items such as cabbage, cantaloups, eggplants, cucumbers and cauliflower are exceptions. It can be seen then, that these savings will help to defray the costs of prepackaging; and they are necessary for the future of the industry. Prepackaging is not likely to expand rapidly if it is assumed that the housewife will pay a premium price for it.

The third factor, "Need for preparation or kitchen servicing by the prepacker," is much more important in the case of vegetables than of fresh fruits. Lima beans, peas, sweet corn, brussels sprouts, spinach and kale are important items in this category. Also prepackaged peeled potatoes offer possibilities for a big market in the future.

The fourth factor is "Relative costs of prepackaging and bulk packaging." The costs of prepackaging are high and are the chief deterrent to a more rapid extension of the prepackaging of fruits and vegetables.

The last and one of the most important factors is, "The effect of prepackaging on the preservation of quality." The main advantage for most vegetables is preservation of moisture content, assuring crispness of

such items as lettuce, celery, asparagus, spinach and other green leafy vegetables.

According to the factors listed, the following vegetables have been rated as having a "good" prepackaging potential: asparagus, snap beans, broccoli, sweet corn, kale, onions, potatoes, spinach and tomatoes. The items that are rated as "fair" are: lima beans and peas (mostly because of the lack of satisfactory shelling machinery and short package life), carrots, cauliflower, celery, lettuce, peppers and sweet potatoes. For items such as carrots and lettuce the outlook would be good except that costs are too high. The items that rate only "poor" in appraising the relative prepackaging potential on the basis of the factors named are: artichokes, cabbage, cantaloups, cucumbers and eggplant.[1]

Types of handlers engaged in centralized packaging. Prepackaging is being done by growers, receivers and retailers. The growers, of course, are located at the shipping point; while the receivers and retailers are situated in the terminal market. The receiver is the commission merchant at the terminal point who sells the fruit and vegetables to the retail outlet. Included under this category is the repacker who buys the merchandise from the commission merchant and processes it for sale in a consumer-type package.

Shipping point prepackaging has proven more successful with the hardware items, such as potatoes, onions, citrus fruits, apples and cranberries

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1 Donald R. Stokes. The Outlook for Prepackaged Produce. United States Department of Agriculture, Production and Marketing Administration, Washington. Address given at the First National Conference on Prepackaging of Fresh Fruits and Vegetables, New York. October 25, 1949, 3 pp.

than with the more perishable commodities; although celery, grapes, plums, rhubarb, peas, tomatoes and blueberries are being packaged there to a lesser degree. At the present time, however, it seems better to prepackage these items in the terminal markets in order to insure freshness and quality because of inadequacies in handling and transportation.[1]

Many wholesalers and repackers are grading, processing and prepackaging certain selected products which they supply to their retail customers. Spinach, cole slaw, salad mixes, and tomatoes were the first items to be handled by these concerns; but other products such as lemons, lettuce, carrots, and so on, have been added to provide a year-round operation.[2]

These enterprises are diverse in scale and methods. One spinach-packaging enterprise might be operated by wholesale produce dealer. Another might specialize in spinach and sell the trimmed and washed products in bulk to other packagers who pack and distribute in their own bags. One of the smallest packaging firms uses a converted residential garage. One of the largest occupies a highly mechanized plant specifically designed for its use and has sold more than 26 million consumer packages of spinach.[3]

Warehouse prepackaging by retailers has been proven to be successful in a number of instances and, with the improvements being made in equipment and materials, their operations will prove to be even more successful. By

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1 Charles W. Hauck. Prepackaging . .A New Industry in the Making. Pre-Pack-Age. September, 1947, p. 9.

2 United States Department of Commerce. Results from Prepackaging Fresh Fruits and Vegetables. Office of Small Business. Small Business Aid No. 378, Washington, 1947, p. 1.

3 G. L. Mehren. Consumer Packaging of Fruits and Vegetables in California. Journal of Marketing. 12:330, 1948.

doing their own prepackaging, they can insure the freshness and quality of the merchandise rather than depending on an outside source to furnish these essentials.

Methods of packaging - techniques, packages and procurement. Most operations are extremely primitive from the engineering standpoint. However, much headway is being made in the way of mechanical equipment and plant organization. Some spinach operations are highly mechanized, with hand labor used only for trimming and for filling packages. The extent to which tomato operations are mechanized varies widely among packagers. Lettuce and celery operations, while small in output, have been highly mechanized. With the exception of spinach, estimates of investment required for packaging a given commodity are meaningless because of the wide variance in plant organization and equipment.

Three types of packages are most widely used. The different types of bags are used for a large number of both fruits and vegetables. The heavier types being utilized for such items as potatoes, onions and citrus fruits; while the more fragile ones are selected for commodities like spinach, cole slaw and cherries. Besides the use of bags, a method by which the product is contact-wrapped in a transparent film which is then heat-sealed, is being developed. The third type of package consists of boxes and boats or trays. When the boats or trays are used, the product is placed inside and it is overwrapped with a transparent film, using machinery of the breadwrapping type.

Supplies are procured by a variety of methods. For example, one large packager contracts in advance of the season with growers much as is done in crops for canning. In this way the firm is guaranteed a stable

buying price and can control both planting and harvesting dates. Other firms buy from local growers and from other packagers. Retailers and small packaging firms usually buy on the wholesale market.

Selling methods. The methods of sale, like those of procurement, vary with the scale of the firm, but all firms prefer to package in conformity with advance orders, mainly so that they can insure a stable selling price. The larger packers even pick up unsold merchandise that is in danger of deterioration to support this procedure. None of them sell on consignment as a regular policy. Where the produce is packaged without advance orders, the pack is carefully held to estimated sales at the fixed price. Even those packers who purchase on fluctuating wholesale markets attempt to maintain a fixed price to retailers, and further try to persuade retailers to maintain fixed prices to consumers.

A few of the spinach prepackagers employ salesmen who contact retailers and wholesalers, but no systematic efforts to manipulate demand at the consumer level have been made. The obvious applicability of brands to the prepackaged products has, however, brought about good opportunity for consumer-demand stimulation.

Distribution in general has been limited to the trucking radius from the point of packaging; although some products are being flown in relatively small volume to markets up to 1,000 miles from the point of packaging. So far, special transit or holding facilities specifically designed to facilitate the marketing of prepackaged produce have not been developed.[1]

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1 Ibid., pp. 330-31.

CHAPTER III

WHY PREPACKAGING?

The trend toward prepackaging of foods in consumer units has long been apparent. The purchasing of foods in bulk by consumers has been discouraged by the combination of modern living customs and shopping habits and limited facilities for food storage in urban dwellings and apartments. Producers and distributors have been quick to realize this, and seek to relieve housewives of as much time-consuming work in food preparation as possible and to simplify their problem of waste disposal by offering an ever-increasing variety of foods partially or completely processed or otherwise prepared. The change is also inspired by the seller's desire to offer products identifiable by label and brand name.[1]

Retail food stores are being converted more and more to self-service, and this means self-service not only in the dry grocery departments, but in the perishable departments of meat and produce as well. And self-service goes hand-in-hand with packaging.

So prepackaging, in part, is the result of changes occurring in our economy; but there are other reasons for the trend toward prepackaging. One of the most important ones is that of waste.

Prepackaging Eliminates Waste

The amount of waste that accompanies conventional practices in the handling and distribution of perishable foods is almost unbelievable.

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1 Charles W. Hauck. Housewives Prefer Pre-Packaged Produce. Columbus Experiment, Consumer Survey, Columbus, Ohio, mimeographed publication, p. 1

Many authorities estimate that about one-fourth of the food produced never is converted into human nourishment but is discarded or wasted somewhere along the line.

Robert T. Oliver, of Syracuse University and the War Food Administration had this to say:

> What agricultural economists have tended to call 'normal wastage' is draining away from 20 to 30 percent of all the food our farmers produce. One pound of food in every four that is grown is destined for the garbage dump! Two hours in every eight worked by our farmers, food processors and food distributors is time thrown away. Twenty-five acres of every hundred-acre farm are plowed, planted, cultivated and harvested with the produce to be finally discarded as waste.[1]

Some of these wastes occur on farms, some in packing houses, some in processing, some in transportation and storage, some in wholesale warehouses, some in retail stores, and some in the homes of consumers and in public eating establishments. The losses on perishable items exceed those on staple merchandise, so it is reasonable to suspect that wastes on unprocessed goods such as fresh fruits and vegetables may be even higher than one-fourth. Rough percentages estimated by William Kling of the War Food Administration add up to these figures: Deciduous fruits, 26 percent; potatoes, 28 percent; tomatoes and citrus fruits, 33 percent; leafy, green, and yellow vegetables, 43 percent. According to his estimates, wastage of fruits and vegetables after leaving the farms amounts to about 20 percent, or more than $800,000,000 annually, at 1942 retail values.[2]

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1 Anon. Normal Food Wastage - A Socio-Economic Problem. American Scientist. 32, No. 4: 268, 1944.

2 Anon. Food Waste in Distribution and Use. Journal of Farm Economics. 25, No. 4:858, 1943.

Mr. Kling states that if these estimates are reliable they indicate that more food is wasted than was consumed annually by the United States armed forces and lend-lease shipments combined during World War II. Mr. Oliver emphasizes the fact that this is enough food "to feed a population of 30 million people - a number equal to the aggregate population of hunger-ridden Belgium, Greece, Denmark, Norway and Czechoslovakia," or, bringing it closer to home it may be added, to feed the combined population of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland and West Virginia.[1]

These figures are especially provocative in view of the immense scarcity of food throughout the world. It is no wonder that they call for a re-examination of existing practices at all points to determine which of them needlessly contribute to waste, and how they may be effectively modified and improved.

The object of prepackaging is to help eliminate these wastes. Prepackaging, through careful preparation and refrigerated delivery of the product to the consumer, makes possible a better utilization of the country's food production. It has been proven by researchers time and time again that packaging and refrigeration saves food and preserves quality without exception in the case of every fresh food product.[2] Ralph David, former editor of Pre-Pack-Age, in an address titled, "Industry's Responsibility in a Defense Program," said that during 1950, over three billion pounds of fresh

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1 Charles W. Hauck and W. L. Lenox. "Normal" Food Waste - Is It Irreducible? Ohio Agricultural Experiment Station, Bimonthly Bulletin 243. 1946, p. 179.

2 Anon. What is the Place of Produce Prepackaging in an Industrial Mobilization Program? Pre-Pack-Age. September, 1950, p. 9.

fruits and vegetables were prepackaged, resulting in a savings for the country of 167,000,000 pounds of food which otherwise would have been wasted. The result was a saving of 17,000,000 man-hours of labor and 7,100 cars, or their equivalent, which would have been required for the transportation of fresh produce items. Mr. David states that the savings are there purely because the prepackaging of fresh fruits and vegetables prior to their arrival at the retail store results in more efficient use of labor and the elimination of a great volume of food waste.[1]

However, prepackaging is not a cure-all for produce merchandising difficulties, but it is a step in the right direction. For example, the necessary trimming, sorting and reconditioning of bulk produce in the retail stores has been found to result in wastes as high as 36.1 pounds of each one hundred pounds of bunched beets received, 32.3 pounds of cauliflower, 20.4 pounds of head lettuce and 14.8 pounds of broccoli. These amounts had to be thrown out by the retailer, and his returns from salable portions had to be large enough to cover his costs and losses on the garbage as well as the salable merchandise. Prepackaged, refrigerated produce, on the other hand, rarely shows losses that are more than 2.5 percent at retail.[2] Furthermore, when unsalable produce and trimmings are segregated in a central location they can be utilized rather than merely being tossed in the garbage can in the retail stores. The edible portions

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1 Anon. Responsibilities and Manpower in Today's Economy. Pre-Pack-Age. April, 1951, p. 28.

2 Charles W. Hauck. New Opportunities in Packaged Perishable Foods. The Ohio State University and the Ohio Agricultural Experiment Station, Columbus, Ohio. Address prepared for delivery at the 17th Packaging Conference and Exposition of the American Management Association, Cleveland, Ohio. April 27, 1948, p. 2.

can be used in soup or salad mixes because, for the most part, they are just as palatable as salable products; while the inedible parts can be used for fertilizers, feeds or mulch.

Opportunities for increasing the "pay load" may be illustrated by head lettuce. This item is available practically the year around. It comes to market from western sources packed in crates which hold five dozen heads on the average. Snow ice is placed between the layers of heads, and the total weight per crate amounts to about ninety pounds. The store in which the observations were made received 38 crates of head lettuce during a two-week period, with the gross shipping weight totaling 3,394 pounds. Of this amount, tare (crate, liner and ice) equalled 797 pounds or 23.5 percent and loss from trimming and damage in displaying and reconditioning the lettuce was 531 pounds or 15.6 percent. The balance of 2,066 pounds or 60.9 percent was salable lettuce.[1] Table 3 shows the results of another survey of sixteen commodities including lettuce.

As this unnecessary weight or bulk is reduced, handling costs decline. Freight and hauling expenses are reduced. Self-service allows retail produce departments to be operated with less labor than before. When the prepackaging is done at the shipping point rather than after arrival in the terminal market, even greater economies are possible.

Prepackaging Adds to the Shelf Life

Perhaps the principal origin of savings lies in the extension of the shelf life of the produce; retention of peak quality and appearance of

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1 Charles W. Hauck. Pre-packaging Reduces Food Waste. Mimeographed publication, p. 6.

TABLE 3

AVERAGE GROSS WEIGHTS, TARE WEIGHTS, AND WEIGHTS OF CONTENTS PER PACKAGE OF SIXTEEN FRESH FRUITS AND VEGETABLES IN STANDARD SHIPPING CONTAINERS RECEIVED IN WHOLESALE WAREHOUSE, COLUMBUS, OHIO, NOVEMBER-DECEMBER, 1946[1]

Commodity	Shipping Unit	Gross Weight Pounds	Tare		Trim and Damage		Salable	
			Pounds	% of Gross	Pounds	% of Gross	Pounds	% of Gross
Apples	Box	51.50	6.00	11.65	4.41	8.57	41.09	79.78
Beans, snap	Hamper	32.86	6.06	18.43	0.01	0.02	26.80	81.55
Beets	Crate	59.00	8.00	13.56	9.19	15.58	41.81	70.86
Carrots, bulk	Basket	27.14	1.34	4.94	1.31	4.81	24.49	90.25
Carrots, bunch	Crate	111.00	19.50	17.57	29.60	26.66	61.90	55.77
Cauliflower	Crate	47.50	6.82	14.36	29.92	62.98	10.76	22.66
Celery	Crate	70.33	10.00	14.22	13.75	19.55	46.58	66.23
Celery cabbage	Basket	17.83	1.96	10.99	2.36	13.23	13.51	75.78
Celery hearts	Basket	18.82	2.07	11.00	4.05	21.52	12.70	67.48
Lettuce, head	Crate	90.80	19.22	21.17	19.23	21.18	52.35	57.65
Lemons	Box	82.06	7.50	9.14	0.48	0.58	74.08	90.28
Parsnips	Basket	11.49	0.97	8.44	0.55	4.81	9.97	86.75
Pears	Box	52.15	6.75	12.94	1.95	3.75	43.45	83.31
Peas	Bu. Bskt.	34.75	5.00	14.39	3.70	10.64	26.05	74.97
Peppers, green	Bu. Bskt.	32.80	5.08	15.49	0.08	0.23	27.64	84.28
Shallots	Barrel	162.00	66.00	40.74	11.79	7.28	84.21	51.98
Turnips	Basket	11.47	0.97	8.46	0.06	0.55	10.44	90.99

1 C. W. Hauck and W. L. Lenox. Tare Weights and Wastes in Marketing Fresh Fruits and Vegetables. Reprint from Farm and Home Research. 32, No. 245, 1947, p. 74.

most items has been lengthened to five days and even longer. In fact, on some items the combination of packaging and refrigeration has prolonged the shelf life to two or three weeks through added protection from physical damage, dehydration and aging. This is in contrast to a shelf life of a few hours or at the most, a day or two when the bulk produce is exposed to unfavorable conditions of humidity and temperature usually prevailing in retail food stores. Table 4 shows the comparison between prepackaged and bulk produce when displayed with cracked ice and mechanical refrigeration as well as under ordinary room conditions.

Prepackaging and mechanical refrigeration together retained the seven vegetables included in Table 4 within 95 percent of the original weight for periods ranging from six to 24 days; or, in other words, from two to seven times longer than any of the other treatments. This combination of factors increased the shelf life of these vegetables more than any other combination tried in these tests.

The prepackaged produce which was refrigerated with cracked ice, and bulk produce held under mechanical refrigeration showed up next best in that order. The prepackaged goods on the cracked ice display counter remained as top quality produce with less than 5 percent weight loss for periods from two to seven days. The bulk produce held under mechanical refrigeration showed immediate weight loss from dehydration, but it took place at a relatively slow rate. Over the period of the experiment, this method compared favorably with the prepackaged cracked ice display.

The bulk vegetables displayed in cracked ice were kept in much better condition than the bulk merchandise that was held under room conditions - conditions similar to those of the conventional dry display produce counter.

TABLE 4

PERCENT OF DELIVERED WEIGHT OF SEVEN PRODUCE ITEMS REMAINING SALEABLE AFTER SUCCESSIVE DAYS OF RETAIL DISPLAY[1]

Commodity	Ordinary Room Conditions					Fine Cracked Ice					Mechanical Refrigeration				
	Number of Days					Number of Days					Number of Days				
	1	2	3	5	10	1	2	3	5	10	1	2	3	5	10
Bulk (not packaged)															
Beans, green	90	82	49	0	-	96	95	87	38	0	99	98	96	94	36
Broccoli	88	0	-	-	-	95	92	54	48	0	97	96	94	92	40
Cauliflower	92	49	0	-	-	98	96	93	46	0	99	98	97	95	66
Celery	91	83	47	32	0	100	98	73	41	22	99	97	96	95	48
Endive	86	58	0	-	-	96	90	63	0	-	97	95	94	91	0
Lettuce	87	78	55	0	-	92	90	90	34	28	95	93	86	82	28
Peppers, green	97	94	30	0	-	100	99	98	94	21	100	99	99	99	94
Prepackaged															
Beans, green	99	39	20	0	-	100	100	100	40	0	100	100	100	100	80
Broccoli	99	84	32	0	-	100	100	77	42	0	100	100	100	100	99
Cauliflower	88	87	74	0	-	100	100	100	77	0	100	100	100	100	73
Celery	100	99	99	86	0	100	100	100	100	46	100	100	100	100	100
Endive	99	98	0	-	-	100	100	100	99	65	100	100	100	100	99
Lettuce	91	90	79	64	0	100	100	100	93	48	100	100	100	100	85
Peppers, green	100	100	99	91	12	100	100	100	100	54	100	100	100	100	92

1 Charles W. Hauck and John J. Crawford. Salable Life of Seven Vegetables. Ohio Agricultural Experiment Station, Bimonthly Bulletin 246. 1947, p. 98.

Bulk produce was kept on the cracked ice display in excellent condition for one to five days with no significant weight loss, but after that trimming and reconditioning accounted for the rapid decline.

This extended shelf life brought about by prepackaging and refrigeration means that nearly every pound of merchandise delivered to the retail store is salable - the retailer does not have to throw out as garbage any part of what he pays for. Also, his costs and profit can be distributed over the total amount of produce purchased rather than having the burden borne by 50, 60, or 70 percent of the lot. This does not mean that rapid turnover is no longer desirable; the retailer still seeks to maintain this, but the added margin of safety is also very welcome.

Growers and wholesalers likewise have a deep interest in any practical means of prolonging the life of these perishable commodities after they have been harvested and prepared for market. Producers and distributors are necessarily concerned with the needs of the retailer and the consumer. Measures that offer greater protection and longer life of fresh vegetables at any point in the marketing process are advantageous in terms of orderly marketing and market stabilization.

Extension of the usable life of fruits and vegetables is also of great concern to the housewife, especially those who like to shop infrequently. Improved refrigeration in homes has made its contribution to this trend. The homemaker is interested in purchasing vegetables that will remain in good condition under refrigeration for a long time.[1]

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1 Ibid. pp. 98-101.

Other Advantages of Prepackaging

It may be that eventually a large premium may be received for certain items sold in this way. Consumers will probably be willing to pay more if they are convinced that prepackaged merchandise insures better quality and better service in the form of less work in preparing, less waste to dispose of in the home, more food value and freshness, better sanitation, less shopping time, et cetera. What the consumer actually wants, though, is a better product at the same or a lower price, and this is just the thing that proper prepackaging gives to her. It has been shown that the reduction of labor costs, waste, handling and housekeeping costs along with such advantages as fewer bottlenecks in the store and increased sales can and does increase store profits without increasing the cost to the consumer. Of course, there is a period of higher costs which Mr. F. L. Thomsen has summed up as follows:

> I can think of few important technological developments in marketing that did not at first involve higher costs than previously-accepted practices. They either overcame this initial handicap through increased volume and efficiency in operation, or consumers and producers accepted them regardless of cost.[1]

On the whole, the offering of packaged fresh fruits and vegetables has met with very encouraging consumer acceptance. In Columbus, Ohio, sales increased sharply in the stores where the conversion was made, and inquiries revealed that the patrons were almost unanimously in favor of this type of merchandising. However, in other studies it was found that some prepackaged commodities did not sell as well as those offered in bulk at first. The prepackaging of carrots without their tops is an example of this. It illustrates the hesitancy of consumers to change well-established

1 F. L. Thomsen. The Marketing and Transportation Situation. United States Department of Agriculture. November, 1945, p. 4.

buying habits in some cases. With the passage of time, these commodities usually outsell the bulk produce too.

These increases in volume which are brought about by prepackaging promise substantial gains to producers by way of expanded outlets, for as Dr. Shepherd of Iowa State College has said, "If all families had sound nutrition we would have to produce one-fifth more milk and citrus fruits than available in 1943 and twice as much green and yellow vegetables."[1] The potential demand is there, and as ways are found to satisfy it, growers can expect it to be reflected in greater demand at the farm, also.

Consumers offer various reasons for preferring to buy produce in this manner. The most important, and the one on which the entire future of the industry rests, is that of quality. There are several things that go to make up quality; they are, market appearance, flavor, texture and nutritive value. It is up to the prepackager to see that all of these quality determinants are present, to a high degree, in the produce that he markets. In order to accomplish this, high-grade merchandise must be properly packaged and kept under refrigeration during shipment and in the retail store.

Research has shown that in order to guarantee a good market appearance the merchandise has to be protected against bruising; moisture loss should be kept at a minimum; natural color has to be preserved; the produce should be devoid of discoloration and spotting caused by disease. Flavor and texture may be kept by retarding the chemical processes that cause deterioration, and by inducing chemical changes that will produce reactions which favor texture and flavor.

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1 Merton L. Corey. Packaging Fresh Fruits and Vegetables. Agricultural Counsel, Carl Byoir & Associates, Public Relations Counsel for the Great Atlantic and Pacific Tea Company. Address given at the Teacher-Retailer Food Conference, Columbus, Ohio, July 28, 1948, p. 4.

The packaging and refrigeration conditions that keep the edible quality of produce intact, usually maintain the highest nutritive value, too. A firm, fresh-looking product, as a rule, not only tastes good, but is of the highest nutritive value, too.[1]

Prepackaging goes far in bringing about these things that go to make up quality. The market appearance is kept at a maximum through the added protection that the packaging gives to the product; and with the development of more and better master containers for the consumer units that packaging is bringing about, there will be more protection from damage in shipment. Protection from damage by retailer and consumer handling in the retail store is provided by the package itself. The moisture loss is also kept at a minimum through proper packaging. Also, with the research inspired through prepackaging, treatments are being developed which will do much to eliminate the discoloration and spotting due to disease.

Flavor, texture, and nutritive value are further enhanced by prepackaging because the prepackager can only keep the confidence of the public by setting up quality standards to protect his brand name. By recognizing the economic advantages of fair trade practices; marketing only quality merchandise; and advertising his belief in his product by associating himself with it; he can benefit himself and the industry.[2]

In addition to the fact that prepackaging may eventually lower rather than raise the retail price of produce, without altering the profit position

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1 Folding Paper Box Association of America. Experiments Show . . . Cartons Protect Quality - Have Consumer Acceptance. Pre-Pack-Age. February, 1948, p. 27.

2 Ibid. p. 29.

of either the producer or distributor, it almost certainly will raise the quality level also. The standards by which these commodities are judged are likely to place greater emphasis on acceptability to the consumer. Plant breeders and commercial growers are likely to be encouraged to produce varieties so delectable and savory as to displace the hardier but less palatable sorts now required by the existing marketing system. Prepackaging probably will bring to the North American consumers a number of exotic, delicate and highly satisfying products now unfamiliar to most of them.[1]

There are various other reasons that consumers offer for preferring to buy produce this way. One of the most important is sanitation. The goods have not been handled by prior customers. There is no litter in the bins or on the floors. Then too, patrons seem to like the convenience and ease with which the produce can be handled in the kitchen and the receptacle simplifies the storing of it and also acts as a dehydrator. The housewife finds that garbage disposal becomes a minor problem. Other patrons emphasize the advantage of being able to shop without being hindered by other customers, and there is a wider choice of fresh, top quality merchandise available during early and late business hours as a result of prepackaging and refrigeration; laborious trimming and preparation of displays by conventional practice in retail stores frequently delays transfer of some items from stock rooms to display counters until mid-morning or later, while the desire of the retailer to avoid losses from overstocking often results in a limited supply of produce later in the day.

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1 Charles W. Hauck. Many Incentives . . . Prompt Consumer Packaging of Perishables. Pre-Pack-Age. November, 1947, p. 12.

There is no waiting to be served by store clerks, and the customer's shopping can be completed more rapidly and with much less inconvenience. Also, emphasis is placed on the fact that the produce taken home in packages is not only better than that offered in open bins, but it keeps longer and permits the housewife to buy in larger quantities and, therefore, to shop less frequently.[1]

1 Hauck. Prepackaging Reduces Food Waste, p. 9.

CHAPTER IV

PROBLEMS

There is a great deal yet to be learned about prepackaging. Many challenging problems are presented that must be met and overcome before some of the advantages can be realized. Some of these are economic questions. Some of them deal with the physical or technological aspects of the subject. Still others concern biological factors, nutrition, health and the like. All of them are so interrelated that each has a bearing on all the rest. In general, they may be classified under seven headings.

Problems Related to Containers

Container costs. Prepackagers are well aware of the additional expenditure required for unit packages and for the master containers used in handling and shipping them. Many of them have found buyers reluctant to absorb these additional material costs. In order for prepackaging to have a fair chance, ways must be found for holding container costs to a moderate level. This is true because prepackaged produce should compete fairly well in consumer value with bulk produce and it should be priced in line with its value to the consumer. It has often been found that an attractive consumer unit of a high quality product will bring a somewhat higher price, but, if priced at a high premium, it will not bring the expected sales.

Some of the questions that need to be answered are: What is the most economical container for a given commodity? What is the relative cost of different container materials? How can the assembling and packing costs

best be held to a minimum? How can these additional container costs best be absorbed?

Container size and type. The determination of the most appropriate and economical consumer-size package has presented a real problem to prepackaging. Sizing the commodity to fit the selected container is likewise a problem. Too many different size containers slow up the packaging operation and increase the handling costs.

Questions that have to be answered along these lines include the following: What size and type of container is best suited for the commodity? Is more than one size of container desirable? How can the most appropriate sizes be standardized? To what multiple or second-hand usage can the used container be put?

Container visibility. Most vegetables contain a large percentage of water which will, under certain conditions, condense onto the inner surface of the package. This fogging or clouding occurs with all films giving protection against moisture losses. This mars the visibility and attractiveness of the affected package.

Some of the questions that need answering are: How can the fogging of film by respiratory gasses be overcome? Is it essential that there be one hundred percent visibility, or does some fogging give an appearance of greater freshness? Which transparent films provide the best visibility?

Container durability. The package must be sufficiently durable to reach the consumer in a neat and unbroken condition if the marketing of a commodity is to be successful. Failure of seams, breakage of paper bags, cracking of transparent films caused by temperature changes, and

deterioration of containers under cold storage conditions are among the problems listed.

Master containers. One of the primary needs of many prepackagers is the development of an economical master container to facilitate handling and to provide adequate protection in transit and storage. Conventional shipping containers are not wholly suited to the needs of soft fruits that must undergo long hauls and much handling, and even the most durable items can benefit from the use of proper outer containers. For example, when five ten-pound bags of potatoes are placed in a strong master bag, handling and warehousing costs are reduced considerably. This outer bag also protects the small units, prevents them from becoming soiled and preserves their attractiveness and salability. Besides strong paper sacks, master containers may consist of specially designed carton boxes, wire bound wooden crates, and boxes of every size and description. They are especially beneficial in reducing breakage of delicate smaller packages. The breakage of even a small number of retail packages hinders selling them and lowers the profit.

Concerning master containers, the following questions are appropriate: For which commodities is a master outer container essential to prevent bruising? To facilitate handling? What is the most economical type of master container? Which produce items require ventilated containers? How can master containers be made to withstand humidity and temperature changes? How does the grower plan to use the box? How is it going to be handled by the commission man? How is it going to be handled by the stores? What alternatives, if any, are there to the use of master containers?[1]

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1 Oscar R. LeBeau. Prepackaging Fruits and Vegetables by Cooperatives. Cooperative Research and Service Division, Farm Credit Administration, Washington, D. C., miscellaneous report 126. October, 1948, pp. 11-14.

Reducing Labor Costs

Labor cost is one of the principal problems with which prepackagers are concerned. It is an outstanding factor when it comes to measuring the efficiency of a packaging operation. The amount of labor needed is closely tied in with the plant arrangement and with the amount of labor-saving equipment. Some prepackagers have undertaken the job with a minimum of additional equipment. The large amount of hand labor needed in this type of an arrangement adds substantially to the packaging costs. Also double and triple handling of numerous small units increases the amount of work required. Hand methods may be used on a temporary basis where only small or experimental packs are involved, but high labor rates usually make it necessary to install labor-saving equipment for volume production. Only by holding the per unit cost of packing and handling to a reasonable figure can wholesale prices for prepackaged produce compete successfully with those delivered in the larger conventional type containers. This may require the installation of bag-filling equipment, wrapping machines, automatic tiers, overhead conveyors, and other labor-saving equipment. One cooperative packaging white potatoes referred to this problem, thus:

> Perhaps our greatest problem . . . is to reduce the cost of packaging. During the past year our packers refused to put up 10-lb. bags at less than 65 cents premium per hundredweight over 100-lb. bags of like quality and size. We feel that it will be necessary to reduce that premium to 50 cents per hundredweight. In order to do that, we must have more efficient machinery in order to cut labor cost.

Some pertinent questions along these lines are: How can labor efficiency be increased? What labor short cuts, if any, can be effected? To

what degree can labor-saving machinery be installed? How can bottlenecks in the packaging line be eliminated?[1]

Expanding Consumer Acceptance

Consumers have to be firmly convinced of the advantage of prepackaged produce. This is necessary in order to gain public acceptance at a price level that will compensate growers and shippers for the increased labor and container costs. Also, the consumer-size packages should not only appeal to higher income families, but to middle income groups as well if total consumption is to be increased substantially. Therefore, the selling price must compare favorably with that of unpackaged items. Prepackers, too, should never forget that the satisfied customer is their best advertisement. The surest way to defeat the purpose of prepackaging is to sell inferior merchandise in a blind container. Consumers, as a whole, expect to find better merchandise in packages.

The suggested research here has to do with the following: What types of containers do consumers prefer? What size consumer package is best suited to the average family's needs? What is the effect of commodity visibility on retail sales? What advertising benefits come from brand identification? Where is the best place for prepackaging to be done so that the consumer will receive the best possible product? How are sales effected when a complete line of prepackaged items are carried rather than only a few such items?[2]

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1 Ibid. p. 14.

2 Ibid. pp. 14-15.

Insuring High Quality Pack

Unless a housewife is satisfied with the quality of the product purchased she is not likely to become a regular customer of prepackaged fruits and vegetables. Prepackagers must be convinced of the importance of marketing only good quality produce. They cannot escape a greater responsibility than before. The respective commodities should be properly graded and sized before placing them in consumer-size packages. While most prepackagers have some perception of the importance of a high quality pack, their actual performance may fall short of the desired goal. For example, one white potato co-op manager reported:

> Our thought has been that due to the higher packing costs, only the best potatoes should be put in 10-lb. bags. In practice, however, much the reverse has been true. Potatoes which were difficult to move in 100-lb. bags were put in the small-sized bags. A large volume of utility grade and culls were also packed in consumer bags. This practice without a doubt has tended to reduce, or in some cases, kill consumer demand for the package.

A similar condition exists in the case of packing oranges in small mesh bags. The packers know that the housewife expects to find the same or better grade of oranges in these bags as are offered in the bin, but the tendency has been for many packers to put chiefly the small size fruit in small bags. This is particularly true in Texas where orange production is a relatively small part of the total citrus crop and where relatively few oranges are diverted to juice plants. The result is that small-size and inferior quality oranges are placed in small mesh bags. The bagged fruit is then sold to truckers who distribute it as fresh fruit throughout Texas and nearby states. Therefore, while Texas produces quite a few oranges, good quality oranges are hard to obtain in many markets of that

state. This surely retards the consumer's enthusiasm for bagged fruit. It also has an adverse effect on overall consumption and the total quantity of oranges that can be marketed successfully.

Where practical, prepackaged produce should be reinspected periodically to protect the consumer from taking home an inferior product. When necessary the packages should be repacked or reconditioned before offering them to the ultimate consumer.

Visibility of the merchandise is also generally desirable. This will tend to give the buyer the added assurance that she is making a good buy, even though she may no longer so readily apply her senses of touch and smell.

Some questions that need to be answered are: How can prepackagers best be persuaded to maintain rigid quality standards? What grading inspection service should be set up to encourage high standards? How can the discoloration of certain commodities packaged in transparent containers be prevented? How can shrinking and decay of prepackaged merchandise be reduced? Where repacking is necessary, how can it be accomplished most economically? What are the effects of prepackaging upon the nutritional values and wholesomeness and palatability of the contents? Is prepackaging suited only to Fancy or No. 1 grades? How many molds and decays be retarded in prepackaged perishables?[1]

Increasing Marketing and Transportation Efficiency

Prepackaged fruits and vegetables must be handled with the greatest of care and dispatch. This involves many modifications in conventional

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1 Ibid. pp. 15-17.

marketing procedures. In part this is a packaging problem, for conventional shipping containers are not wholly suited to the needs of prepackaged produce. With some commodities it may require the development of an inexpensive master container that will reduce handling costs and provide adequate protection in transit. For example, oranges that are shipped in mesh bags without the protection of a master container are likely to look bruised and unattractive by the time they reach distant retail outlets. At the same time it is understandable that shippers hesitate to spend about 40 cents additional for a master container which is equivalent to adding about four cents to the marketing cost of each eight-pound bag.[1]

Refrigeration equipment frequently is inadequate, both for the necessary precooling at points of origin and for maintaining proper atmospheric conditions in transit, in wholesale and jobbing warehouses, and in retail stores. Much commercial packing-house equipment and other physical facilities between the farms and the retail outlets should be redesigned in accordance with these newer objectives.[2]

Transportation also plays a vital part in the distribution of fresh fruits and vegetables. Prepackaging at shipping points has no hope of success unless the products can be moved safely and economically in that form. Faster transportation is necessary, with a possible emphasis on air cargo in the future. Better methods of sanitation, mold control and other measures to retard deterioration need to be employed.[3]

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1 Ibid. pp. 17-18.

2 Charles W. Hauck. Many Incentives . . . Prompt Consumer Packaging of Perishables. Pre-Pack-Age. November, 1947, p. 11.

3 Charles W. Hauck. Pre-packaging Reduces Food Waste. Mimeographed publication, p. 13.

Another problem that the source prepackager will have to work out is that of distribution. The products of the source prepackager have no place in the produce auction markets of this country; so the sooner that he can get away from them the better for him, the industry and the quality of the produce.[1]

Some of the questions raised are: How can prepackaging and handling costs be held to a minimum? What, if any, distribution costs can be eliminated? What are the comparable transportation costs for prepackaged and bulk merchandise? How can refrigerator cars and trucks be improved to facilitate the shipment of prepackaged produce? How can retailers be encouraged to handle and display prepackaged fruits and vegetables most effectively? What equipment is needed? What is the best way to distribute the prepackaged merchandise?

Improving Prepackaging Equipment

There is general agreement among prepackagers that if consumer-size packages are to compete successfully with conventional bulk produce, marketing ways must be found to reduce the large amount of hand labor normally required. Therefore, the development of appropriate conveyors, vegetable washers, graders, packing machinery, closing machines and other mechanical equipment offers a wide field for helpful research. For example, equipment needs to be developed to shell green lima beans and peas gently and economically. The existing viners and podders turn out too many bruised and damaged beans, which makes the products unacceptable on the fresh market. Bruising is reasonably acceptable to canners and processors

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1 Editor. Bagged by the Editor. Pre-Pack-Age. August, 1950, p. 2.

when the beans are to be immediately blanched and processed, but it is intolerable when the beans are offered in the fresh state.

Some of the larger operators are already utilizing substantial labor-saving equipment. A potato cooperative has this to say:

> We must continue to perfect our packaging methods in order to bring prices of consumer packages down to a near level of commodities packed in larger units. Our prepackaging in the past has been antiquated with most of it being done by combination machine-hand method. We have been doing some research and development work at substantial cost in an effort to perfect an automatic weighing and packaging machine.[1]

Other prepackagers are planning to install special packaging machinery in the near future. It is the consensus of opinion that efficient prepackaging equipment is the first step to economical large-scale output. It may be said that the speed with which the prepackaging industry progresses is dependent upon the speed with which automatic equipment and adequate packaging materials are developed. The manufacturers of machinery, equipment and materials are important in this respect; but of equal importance are the men and companies who are pioneering in this field. They are the ones who are "taking the bumps" now in order to smooth some of the problems out for the future.

Suggested research: What kinds and types of equipment are best adapted to make prepackaging easier and better? To what extent are packaging machinery firms already working on this problem? Can some of the present mechanized equipment be converted to do the specific job at hand? What new equipment needs to be developed to lower the per unit costs for prepackaging and handling?

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1 LeBeau, Op. Cit., p. 18.

Utilizing Refuse

Since only the higher grades of produce are suitable for prepackaging, new and additional outlets have to be developed for the fruits and vegetables that do not come up to the desirable specifications. Some produce discarded in the prepackaging process is just as fresh, appetizing, wholesome and nutritious as that which is packed and sold. For instance, leaves broken from heads of lettuce or stalks of celery, grapes separated from the bunch, bananas loose from the hand, carrots and radishes torn from the bunch and other items of a similar nature may be unsalable, but at the same time they are edible. Nevertheless, they are discarded with the inedible trimings and damaged foods. A broken cucumber or apple with a noticeable stem puncture or package cut must usually be thrown away, even though it may be almost entirely edible.

Some packers reclaim some of these losses in the form of cut salads, salad and soup mix combinations, jellied fruit desserts, peeled and sliced potatoes, and others. Also, where feasable, a common practice is to divert this type of produce to juice plants and canneries.[1] Then too, some off-grade or under-size white potatoes may be utilized for the production of useful by-products such as starch, flour and alcohol. Others are appropriate for livestock feed, either in the fresh or dried form. For example, citrus refuse is becoming increasingly important as a source of cattle feed. The Texsun Citrus Exchange at Weslaco, Texas, produces enormous quantities of dried citrus pulp and molasses each year from citrus refuse. Finally, all fruits and vegetables have value as fertilizers.

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1 Hauck. Prepackaging Reduces Food Waste. p. 3.

In conventional marketing, low grade produce has sometimes not been rejected until it has reached the retail store where it is then discarded at a loss to the retailer. It can readily be seen that prepackaging is not going to prosper under these conditions, and the needless waste of containers, freight and labor can be enormous.

Again, methods and equipment need to be developed to convert trimmings into useful products and to provide some income from what is now an expense and a disposal problem.

The problems that present themselves are: What is the possibility of utilizing discarded produce as processed food? As a fuel? As raw feed for livestock? As dehydrated feed for livestock? What other by-product usage can be discovered for such refuse? What part, finally, is of no value and can only be disposed of as economically as possible? What are the engineering requirements - equipment, power, water, space, arrangement, et cetera? How will costs of prepackaging be affected by conversion of some of these wastes and losses from expense to income?[1]

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1 Ibid. pp. 3-4.

CHAPTER V

PACKAGES AND FILMS

Self-service would be impossible if it were not for the developments and refinements in packaging materials and packaging techniques that have been the forerunners. Since its inception, self-service has followed closely behind packaging improvements. During the past, whenever an item appeared on the market in a neat, durable, and attractive package, merchants offered it for sale on a self-service, help-yourself basis. Invariably sales increased when so merchandised.

At first self-service was confined almost exclusively to the dry grocery items because of their adaptability to packaging. Tin cans, glass containers and paper cartons served to give dry groceries the characteristics and appeal required for self-service. Later transparent packaging materials came along, and immediately bulk dry grocery items such as cookies, cakes, dried fruits and dried beans attractively bagged in these transparent materials found their way into the retail stores.

In recent years improvements and refinements in packaging materials and packaging techniques have enabled merchants to extend self-service merchandising to other than dry grocery departments. The perishable foods are now finding their way into open refrigerated self-service display cases, attractively packaged. Fresh meats, fresh fruits and vegetables, and cheese are proving appropriate items for self-service merchandising.[1]

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1 Carl Dipman, Robert W. Mueller, and Ralph E. Head, Editors. Chapter 16, Packaging Perishables for Self-Service. Self-Service Food Stores. New York: The Progressive Grocer. 1946, pp. 223-225.

Prepackaged produce presents many problems that are not inherent in packaged grocery items. There are about 227 varieties of produce. These varieties have characteristics which are determined by weather conditions, topography, chemical composition of the soil and the season during which they grow. The life of a lemon after it is picked is even affected by the age of the tree that it grew on.

Processed foods are not living - fruits and vegetables are. They need to breathe, and consequently, require a container that will allow them to do so. They also require a container that will afford the needed protection from the time they are packaged until they are ready for consumption in order to maintain their appearance, nutritive values and taste. So it is necessary when packaging these items not only to take into consideration the conventional methods of packaging processed merchandise, but also all of the other factors that are important where perishable, living products are concerned. Some of the varieties of produce are durable and need little protection, while some are very fragile and require a maximum degree of protection.[1]

Packages

Attributes of a good package. In some districts customers seem to resent prepackaging when it is first introduced. It is only when they come to believe that they are receiving the same or better merchandise at a reasonable price that they finally accept it. It is not enough for the

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1 Folding Paper Box Association of America. Experiments Show . . . Cartons Protect Quality - Have Consumer Acceptance. Pre-Pack-Age. February, 1948, pp. 27-28.

package to be merely pretty or to be used as a means of selling cellophane or some other packaging material. The acceptable consumer unit has to be utilitarian - it must possess the following characteristics if it is to do an adequate job of attracting impulse purchasers:[1]

1. The package must attract attention. It must compete effectively in the all-important split second to catch a prospective purchaser's eye and hold it. It has to be a "shopper stopper" in every sense. Color, design and shape are very important in this respect.

Colors should be chosen because they have visual impact and not just because they look good to someone. It has been proven that red and yellow both fall into the category of high-impact because they have excess visual vibration and can attract that attention which is so necessary for increasing impulse sales.[2] A package showing a full-color reproduction of the fruits and vegetables as they come out of the garden with the emphasis on the high-impact colors could go a long way in increasing impulse sales through the intelligent use of silent salesmanship.

The design of the package should provide strong identity, personality and appeal. It must attract attention and develop interest. Also, it should give some information about the product in order to clinch the sale and give satisfaction to the customer after it is taken home.

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1 General Outline Taken From:
United States Department of Commerce. Increasing Impulse Sales Through Packaging. Small Business Aids, Washington, D. C., Bulletin 189. 1947, 3 pp.

2 Egmont Arens. Chapter 18, Packaging for the Mass Market. Sayres, Paul, Editor. Food Marketing. New York, Toronto and London: McGraw-Hill Book Company, Inc., 1950, p. 226.

The shape of the package is also important to the consumer, but it is of more importance to the retailer who has to stack and display the merchandise. Odd-shaped packages can make this job difficult.

2. The package must build confidence. This is one of the most important aspects of prepackaging. The prepackager can build up goodwill by doing a good job of prepackaging fresh, quality merchandise just as the grocery manufacturers have done with their products. In turn the retailer can sell a well-known brand more readily and with fewer repercussions, and the consumer can buy the brand with confidence in the merchandise, which will do much to enhance the place of prepackaging in the self-service store of today.

3. The package must look clean and sanitary. Shoppers - women shoppers especially - are becoming more and more sanitation conscious. This is increasingly evident in the attitude toward the purchase of food.

In this respect, the consumer units must be kept in good condition while being transported. So suitable master containers are of prime importance. They must provide maximum protection for the packages enclosed. It does no good to package produce if the packages are not going to remain in good condition until they are intentionally opened by the ultimate consumer.

Also the contents must be clean and free from all insect contamination. If the produce is packaged in a saleable condition, it should remain in that condition if the proper container is used.

4. The package must be convenient to handle to carry out of the store and to use. Prepackaging itself has greatly increased the convenience of handling fresh produce. People no longer have to wait around for the clerk

to weigh their produce purchases. They can pick up the quantity they desire already bagged or wrapped with no fuss or bother.

Improved opening devices and reclosures on packages are examples of satisfying the public in the matter of use and reuse. Polyethylene and pliofilm bags have many uses and can be used over and over again in the household. Those with the elastic closures are particularly convenient.

5. The package must look like a good value. Millions of American housewives are finding that their dollars will not go as far in buying food and other commodities. Consequently, the package that looks like "full money's worth" is likely to do a real job in clearing up doubts.

6. The package must provide adequate visibility. The more visibility that it has, the more acceptable it becomes to the consumer. This is only natural because, no matter how good the produce, there are bound to be some specimens that are not up to par as a result of deterioration or being subject to one or more of the several undesirable conditions to which it may be exposed. This condition is recognized in state and federal grading of fresh fruits and vegetables by permitting a certain tolerance. Most retail shoppers realize this, because of past experience, and, therefore, find it not only desirable but essential to inspect the produce before making their final selection and purchase.

7. The package must be a convenient size. The size of the consumer unit is important and should be given a lot of thought by the prepackager and merchandiser. The size is determined by two things - the commodity and the price. A container large enough to hold four fair-sized servings is desirable for items like spinach, kale, slaw and mixed salad; while with

other commodities such as apples and oranges it is desirable to use the largest container that a customer will accept.[1]

To take care of the fluctuations of prices, there must be provision for use of more than one unit size. For example, during the 1948 season a two-pound unit of McIntosh apples retailed for 29 cents; during the 1949 season with a larger crop and lower prices, a four-pound unit retailed for the same price. Flexibility of package size is, therefore, of great importance in meeting price variations and retail requirements.[2]

8. The package must meet legal requirements. The acceptable consumer unit has to meet certain legal requirements. The package must give the name of the commodity, the packer or distributor and his address, and the count or net weight. If any preservative, coloring or other foreign material has been added to the product, this also must be given in clear lettering on the package. It is also the responsibility of the retailer to make sure that the net weight of the produce is equal to or more than that designated on the package. There are a few states that require additional information; for example, in Michigan it is necessary for tomato prepackagers to include the words "Not Vine Ripened" on each consumer unit.[3]

In addition to these consumer factors, there are several factors important from the standpoint of the seller. They include the following:

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1 Earl D. Mallison. What Makes An Acceptable Consumer Unit? Pre-Pack-Age. November, 1949, p. 16.

2 Gilbert F. O'Brien. Some Thoughts on Self-Service - And Prepackaging. Pre-Pack-Age. April, 1950, p. 26.

3 Mallison, Op. Cit., p. 16.

1. The package must look like a fast seller. The shrewd retailer knows that fast turnover is one of his principal assets. His past experience concerning which types of packages sell and which do not sell will be drawn on in making his decision whether to stock the packaged product that is offered to him.

There appears to be an increasing demand for small containers because of the decrease in the size of families and the limited amount of storage space in small homes and newer apartments. Smaller containers are reported to tend to reduce the amount of product waste to the consumer. Consequently, there is often sales resistance to the larger sized containers.

2. The package must deserve a preferred display. If the package is a good one, the retailer will give it preference over the same merchandise in a not-so-good package. A great deal of merchandise can be sold in addition to that which would ordinarily be sold if a preponderance of retailers "push" the product because of its superior packaging.

From the retailer's viewpoint, packaging is well on the way to being successful if it helps stimulate sales. Retailers want items packaged so attractively that they not only sell the customers in the store but will also sell them again when the packages are opened at home. Retailers are concerned with consumer's satisfaction in the merchandise. Packages should not over-shadow contents, i.e., as to price, size, et cetera. Retailers dislike overpackaging that adds great expense to the retail price of the merchandise and particularly when the cost of the packaging, as in so many instances, exceeds the value of the contents.

3. The package must be convenient to stock and display. Prepackaging conscious retailers suggest that suppliers become time conscious in the ways

of retailers in order to save the costs involved in unpacking, repackaging (fruit and vegetable containers should be developed which would permit the retailer to replace that portion of the food which may have become discolored or otherwise deteriorated in the original sealed container, e.g., prepackaged tomatoes), marking as to size, price, et cetera, and stacking methods which are necessary in the handling of bulk merchandise. Prepackaging by itself offers definite advantages in that commodity is contained in the original manufacturer's package, which facilitates stacking, expedites delivery and brings merchandise nearer the customer; but the suppliers should have the following things in mind when designing a package: (a) a package that will minimize loss in handling, (b) display more merchandise per square foot, (c) consume less warehouse space, (d) reduce damages by climatic conditions, and (e) perform the task of a silent salesman.

4. The package must prevent spoilage during the selling period. The package must provide ample protection and also be adaptable to each individual produce item in order to secure a minimum of loss from bruising, dehydration and suffocation. This is necessary because there is a difference between the durability, moisture loss and breathing rate of each produce item. Take potatoes and peaches for example; potatoes are durable and have a low moisture loss and a low breathing rate, while peaches have just the opposite characteristics.

In the case of sweet corn the breathing rate is so high that it will tend to suffocate even when a breathing type film is used as a wrap. The only thing that will prevent this is refrigeration - and the sooner the

better. The refrigeration slows down its respiration so the breathing type of film can handle it. At the same time the film retains much of the corn's moisture, which retards dehydration.

5. The package must resist soiling. Dust and handling are constant enemies attaching packages that were clean and attractive when they left the prepacker's plant. As better packages are developed - packages that will protect the produce against physical injury from unnecessary handling by the consumer in the store, and strong enough to hold and transport the produce, even though wet or damp - along with a well-disciplined labor force, these conditions will be held to a minimum.

6. The package must be easy to fill and close. This is important from the prepackager's point of view. In order to fit in with the mass production pattern of today the container has to meet these requirements.

In summary it can be said that the effective package should do two things: It should be an advertisement and it should be a salesman.

Basic containers used for prepackaged produce.[1] Produce containers fall into three general categories. They are as follows:

1. Plain kraft bags, transparent bags, mesh bags and window bags. The plain kraft bags are not used very often in the prepackaging of produce

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1 This information was obtained from the following sources:

Anon. Pre-Packaging Fresh Fruits and Vegetables in the Store. Published through the Consumer Education Project of Michigan State College, mimeographed publication. 2 pp.

United States Department of Commerce. Prepackaging of Produce in the Retail Store. Small Business Aids, Washington, D. C., Bulletin 408. 1948, 2 pp.

M. M. Zimmerman, Editor and Publisher. What's Ahead in Pre-Packaged Produce. Reprinted from a series of four articles published in Super Market Merchandising. July, 1945 to October, 1945, Part III, pp. 12-13.

except for potatoes; because the contents are hidden and the majority of the consumers do not like to buy a "cat in the bag." The transparent bags, on the other hand, provide maximum visibility. The more fragile ones are used as containers for the lighter commodities, such as spinach, mixed salads and soup vegetables; while the more durable transparent bags, mesh bags and window bags are used for the hardier produce items which are usually sold in large quantities, such as dry onions, oranges, apples and grapefruit. Bagged merchandise is easy to display effectively, and bagging usually results in larger sales.

2. Transparent film used as a wrapper. The film can either be used as an individual wrap or as a bunch wrap. When it is used as an individual wrap, it is wrapped around one article such as head lettuce; when it is used as a bunch wrap, the wrapper is applied to a standardized weight on a group of items as in the case of asparagus or broccoli. In both bunch and individual wraps, the film is applied directly to the merchandise.

3. Plain paper boxes, transparent window boxes; and paper boxes, tills, trays, cartons, baskets, U-boards, and flat-boards covered with transparent film. The plain paper boxes, such as those used for prepackaging mushrooms, have small perforations in them so that the produce can breathe, but the contents cannot be seen. The transparent window boxes have the advantage over the plain boxes in that the produce can be seen without removing the cover. Window boxes are used for items like pears, peaches, and cranberries.

The paper boxes, tills, trays, cartons, baskets, U-boards and flat-boards are all used similarly. The merchandise is usually placed in these containers by hand, and then they are machine-wrapped with a transparent

material. The containers provide a needed support for most machine wrapping, and serve as a protection for the produce. They allow for fast, mass prepackaging and are widely used.

These paperboard materials should be water resistant for wet produce as other types will get soggy and limp. They should be made so that they can be easily set up, and should possess sufficient structural strength. They can be colorfully printed thereby permitting the use of unprinted film. Machinery has been developed that will set up trays automatically. Also a number of semi-automatic wrapping machines are being used by the large packers. Some of these have a self-measuring paper feed, thus permitting the overwrapping of heaping full trays.

The question of using bags versus trays on certain items will depend on the type of package desired and other factors such as cost and production speed. There are many commodities which have been packaged with equal success in both types, although for some, like spinach, the bag is preferred. It is important to use water resistant adhesives for bags and cartons[1] intended to be used on wet products.

Films

Reasons why different types of film are used. In order to determine the proper type of film to use, it is necessary to know where the packaging is done, i.e. at the source, at the distribution level (wholesaler, centrally located warehouse, repacker, et cetera), or in the retail store. It

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1 Anon. Fruit and Vegetable Prepackaging. American Viscose Corporation bulletin. pp. 4-5.

can be said that the nearer the packaging is done to the consumer point the safer it will be.[1]

Also, different films are used because a fresh fruit or vegetable is a living thing. It gives off moisture and various gases in its normal respiration or "breathing." These physiological characteristics of produce items vary from plant to plant and from fruit to fruit, so that it is impossible to make any generalizations. For instance, the reduction in the oxygen content of the atmosphere can either be beneficial or harmful to the vegetable depending upon the product, the concentration and time involved. The carbon dioxide concentration, likewise, can be either a detriment or a help. No matter what type of film is used in a package, if an air-tight seal is employed there will be a tendency for the oxygen to decrease and the carbon dioxide to increase.[2] Interference with the normal gas exchange of the produce may result in sub-oxidation, off-flavor and mustiness. Peas, sweet corn, asparagus and, to a lesser degree, all vegetables and fruits are subject to sub-oxidation. The best means of avoiding this undesirable process is by the use of proper refrigeration from the time the produce is picked until it is consumed, and by the use of films that will allow each produce item to do the breathing that is necessary.

If the film that is used happens to be moistureproof in addition to being air-tight, the atmosphere within the package will become saturated with water vapor. This reduces wilting to practically nothing, but sliming and other forms of decay are speeded up, and the moisture condenses

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1 Ibid. p. 1.

2 F. W. Spannagel. Films. Pre-Pack-Age. November, 1949, pp. 6-7.

on the film, making it soft and limp and causes fogging and poor visibility.[1]

There is a wide difference in structure, chemical composition, and physiological behavior in each particular produce item, and, therefore, they each present a different problem. For example, leafy vegetables deteriorate primarily because of wilting, which can be controlled by packaging in moistureproof containers; sweet corn, peas and asparagus lose quality as a result of rapid sugar losses, which can be checked best by proper refrigeration and speedy marketing; root crops and potatoes suffer from bruising, and to a lesser extent from shriveling. Nearly all vegetables are subject to storage diseases, which develop most rapidly when exposed to high temperature and high humidity.[2]

Types of film used.[3] Cellophane is the most widely used film for the prepackaging of produce because of its versatility. There are two types of cellophane available from E. I. du Pont de Nemours Company and the Sylvania

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1 Marie Bentivoglio. Practical Discussion . . . Of Films for Prepackaging Produce. Pre-Pack-Age. February, 1948, pp. 26-27.

2 M. P. Rasmussen and H. Platenius. Produce Prepackaging in New York and New England. Modern Packaging. 19, No. 11: 129, 1946.

3 This information was obtained from the following sources:
Letter from Mr. A. S. Allen of the Sales Development and Technical Service Department of E. I. du Pont de Nemours and Company, Wilmington, Delaware. May 1, 1951.

Spannagel, Op. Cit., p. 7.

Technical Editor. Gas Transmission of Transparent Films. Modern Packaging. 23, Pt. 1; 138, 1949.

Hans Platenius. Films for Produce. . . Their Physical Characteristics and Requirements. Modern Packaging. October, 1946, p. 170.

Division of the American Viscose Corporation - moistureproof and semi-moistureproof. These two firms have worked out specific recommendations for different commodities. By using a wide variety of coating formulations, they have made the film adaptable to wet or dry produce items - water resistant coated types being used for wet products, and non-coated types for the dry products.

The plastic films include cellulose acetate, pliofilm, and polyethylene. Cellulose acetate has become popular in the prepackaging field because it is water resistant, highly permeable and free from condensation. On the other hand, though, it is not moisture retentive and it is necessary to use a solvent for sealing because of its poor heat sealing properties. It is manufactured by Celanese Corporation of America (under the trademark, Lumarith), E. I. du Pont de Nemours (as cellulose acetate) and Eastman Kodak (as Kodapak). It finds its best applications to those items where moisture retention is not needed or can cause damage.

Pliofilm, a film of high tear-resistance, is manufactured by the Goodyear Tire and Rubber Company. It is a rubber hydrochloride of which several formulations have been tested and used commercially. It is water vapor-proof and has a weld type heat seal. Also, it is intrinsically water resistant. It has been used for the individual overwrapping of fruits and vegetables, and apples and oranges have been packaged in three to ten-pound units.

Polyethylene is a film which retains moisture in a package very well. It is also very strong and lends itself to making packages for five and ten-pound units for which the cellophane films are not suited - three pounds being about the maximum for them. Polyethylene is being used for bagging

apples, oranges and potatoes in the larger units, and one-pound bags of topped carrots packed at the grower level.

All of these films are available in various thicknesses. Thus, it is possible to fit the desired strength to the particular item being prepackaged.

The primary object of using transparent films for prepackaging fruits and vegetables is to have a packaging material which makes the product visible to the consumer and reduces excessive wilting and shrinkage losses. Most of these transparent films meet these requirements reasonably well. However, films which provide maximum visibility are not very effective in reducing moisture losses and vice versa.

Experimental data have shown that all of the films now used for prepackaging possess a low permeability to oxygen. If seals are made airtight, the supply of oxygen is insufficient to maintain a normal course of respiration of the packaged produce and there is a rapid breakdown. Usually films which have a low permeability to water vapor are also highly impermeable to oxygen; so in order to avoid possible breakdown from anaerobic respiration it is recommended that some degree of ventilation be provided for all packaged produce. This can be accomplished by punching small holes into the film, by using staples instead of seals to close bags, by lap-sealing, and otherwise making imperfect seals. It has been proven that these types of ventilation have no appreciable effect on the rate of shrinkage and wilting of the product. The tightness of seals and seams, the grade or type of the film, the moisture in the package, the temperature and humidity of storage and the question of whether light and air circulation are

used, all have a bearing. When the effects of all of these variables are either known or held constant, the gas transmission of the film may be a critical matter.

A film has not yet been invented that will take care of every item of produce in a desirable manner, and until one is developed, it will be necessary to select the best film, or to provide the necessary ventilation wherever required. The all-purpose film will have to be moisture retentive, substantially free of condensation under fluctuating conditions of temperature and relative humidity, permeable to oxygen to a fairly high degree, easy to seal and convert and be reasonably inexpensive.

Table 5 presents a prepackaging chart for fruits and vegetables. It gives a picture of the preparation that should be done for each commodity, the type of package usually used, the desirable film to be used and the ventilation and refrigeration that is desirable.

TABLE 5

PREPACKAGING CHART FOR FRUITS AND VEGETABLES[1]

Item	Preparation	Type Package	Film[2]	Ventilation	Refrigeration
		Vegetables			
Asparagus	Wash, precool. Remove damaged spears. Trim butts evenly.	Direct wrap Bag	300 LSAT 450 LSAT	Essential	Highly desirable 32-45°
Beans in pods (green, wax, lima)	Sort out damaged, immature beans. Do not break stems or tips. Keep dry.	Bag	450 LSAT	Essential	Highly desirable 32-45°
Beets	Remove damaged, decayed beets. Trimming tops optional.	Direct wrap Tray overwrap	300 LSAT 300 LSAT	Essential	Desirable 32-45°
Broccoli	Wash, precool. Trim yellowed leaves, open buds, damaged stalks. Avoid crushing.	Direct wrap Tray overwrap	300 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Brussels sprouts	Sort out yellowed, mashed, diseased sprouts. Trim. Precool.	Hood on basket Bag	300 LSAT 450 LSAT	Essential	Highly desirable 32-45°

1 Made up by the Film Department of E. I. du Pont de Nemours Company, Inc., Wilmington, Delaware.

2 LSAT film: L-Less moisture retention than moistureproof film; A-Anchored, which makes it water-resistant; S-Heatsealing; T-Transparent (uncolored)

TABLE 5, continued

Item	Preparation	Type Package	Film	Ventilation	Refrigeration
Carrots	Sort out damaged, decayed roots. Trimming tops optional.	Bag Tray overwrap	(450 LSAT or (150 Polythene 300 LSAT	Essential (For Polythene bag- $8\frac{1}{4}$" holes)	Desirable 32-45°
Cauliflower	Trim jacket even with flowers. Keep dry, cool. Damaged, oversize heads - cut into segments.	Direct Wrap Bag Tray overwrap	300 LSAT 450 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Celery	Trim butt, damaged leaves, branches. Trim to table length. Wash.	Direct Wrap Bag	300 LSAT 450 LSAT	Essential	Desirable 32-45°
Corn	Husk, trim, remove silk. Precool to at least 40°.	Bag Direct wrap	450 LSAT 300 LSAT	Essential	Highly desirable 32-40°
Endive	Trim damaged, discolored leaves.	Direct wrap Bag	300 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Greens (collards, dandelion, kale, mustard, spinach.)	Pick out damaged, discolored leaves. Wash to clean and cool.	Bag	450 LSAT	Essential	Highly desirable
Lettuce, head	Trim butt, damaged, discolored leaves.	Direct wrap Bag	300 LSAT 300 LSAT	Desirable	Highly desirable 32-45°

TABLE 5, continued

Item	Preparation	Type Package	Film	Ventilation	Refrigeration
Lettuce, leaf	Trim damaged, discolored leaves.	Direct wrap Bag	300 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Mushrooms	Wear gloves when handling to avoid spotting. Keep dry. Package rapidly to avoid moisture loss.	Window top carton Bag	(300 LSAT or (100 CA-43 300 LSAT	Essential	Highly desirable 32-40°
Onions, dry	Sort out decayed, sprouted onions. Keep dry, cool.	Bag Window Bag	450 LSAT (150 Polythene for 3 lbs. and over) 450 LSAT	Essential (for Polythene bag- $16\frac{1}{4}$" holes)	Store temperature
Onions, green	Sort out damaged onions.	Direct wrap Bag	300 LSAT 450 LSAT	Essential	Highly desirable 32-45°
Parsley	Remove damaged leaves. Wash.	Bag	300 LSAT	Essential	Highly desirable 32-45°
Parsnips	Roots should be firm, crisp; color bright. Keep dry.	Bag Tray overwrap	450 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Peas, in pods	Remove decayed, slimy pods.	Bag	450 LSAT	Essential	Highly desirable 32-45°

TABLE 5, continued

Item	Preparation	Type Package	Film	Ventilation	Refrigeration
Peppers	Remove damaged peppers. Examine for soft spots.	Bag Tray overwrap	450 LSAT 300 LSAT	Essential	Desirable 32-45°
Potatoes (late, new)	Sort out damaged potatoes Grade to size. Keep dry, cool.	Bag	450 LSAT (150 Polythene for 5 lbs. and over)	Essential (Polythene 5-lb. bag- $24\frac{1}{4}$" holes. 32 holes for 10 lbs.)	Store temperature
Radishes	Sort out damaged radishes Trimming tops optional. Wash to clean and cool	Bag Direct wrap	450 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Squash, winter	Cut into segments. Keep dry, cool.	Direct wrap	300 LSAT	Essential	Desirable 32-45°
Sweet potatoes and yams	Sort out damaged sweet potatoes or yams. Keep dry, cool.	Bag Tray overwrap	450 LSAT (150 Polythene for 3 lbs. and over) 450 LSAT	Essential (for Polythene bag- $24\frac{1}{4}$" holes)	Store temperature
Tomatoes	Remove damaged overripe tomatoes. Grade for ripeness. Display only fully pink tomatoes.	Tray overwrap Bag	(300 LSAT or (100 CA-48 450 LSAT	Essential	Store temperature (can refrigerate when fully ripe)
Turnips	Cut off roots and tops. Keep dry.	Bag Tray overwrap	450 LSAT (150 Polythene bag for 3 lbs. and over) 300 LSAT	Essential (for Polythene bag- $8\frac{1}{4}$" holes.)	Desirable 32-45°

TABLE 5, continued

Item	Preparation	Type Package	Film	Ventilation	Refrigeration
		Fruits			
Apples	Sort out damaged fruit. Avoid bruising.	Bag	450 LSAT (150 Polythene for 5 lbs. and over)	Essential (for Polythene bag- at least $2\frac{1}{4}$" holes	Desirable 32-45°
		Tray overwrap	300 LSAT		
Apricots	Sort out damaged fruit. Avoid bruising.	Tray overwrap	300 LSAT	Essential	Desirable 32-45°
Bananas	Cut off damaged, overripe bananas. Small loose bananas-package together in tray.	Direct wrap Tray overwrap	300 LSAT 300 LSAT	Essential	Store temperature
Berries	Sort out damaged, moldy berries. Handle carefully.	Hood on basket	300 LSAT	Essential	Desirable 32-45°
Cherries	Sort out damaged, malformed cherries. Handle carefully Leave stems on. Keep dry.	Bag Tray overwrap	450 LSAT 300 LSAT	Essential	Highly desirable 32-45°
Cranberries	Sort out damaged, decayed berries.	Bag	450 LSAT	Essential	Desirable 32-45°
Grapefruit	Sort out damaged fruit.	Bag	450 LSAT (150 Polythene for 5 lbs. and over)	Essential (for Polythene bag- $32\frac{1}{4}$" holes)	Desirable 32-45°

TABLE 5, continued

Item	Preparation	Type Package	Film	Venti-lation	Refrig-eration
Grapes	Clip off moldy, damaged grapes with scissors. Keep dry.	Tray overwrap Bag	300 LSAT 450 LSAT	Essential	Desirable 32-45°
Lemons	Remove damaged fruit. Lemons must be dry when packaging.	Bag Tray overwrap	(450 LSAT or (150 Polythene 300 LSAT or 100 CA-48	Essential (for Polythene bag-at least $6\frac{1}{4}$" holes)	Desirable 32-45°
Limes	Sort out damaged fruit.	Bag Tray overwrap	(450 LSAT or (150 Polythene (300 LSAT or (100 CA-48	Essential (for Polythene bag-at least $6\frac{1}{4}$" holes)	Desirable 32-45°
Nectarines	Remove damaged fruit. Keep dry. Handle carefully.	Tray overwrap	300 LSAT	Essential	Desirable 32-45°
Oranges	Pick out damaged fruit. Oranges must be dry when packaging.	Bag Tray overwrap	(450 LSAT (150 Polythene for 5 lbs. and over) 300 LSAT	Essential (for Polythene bag-$32\frac{1}{4}$" holes)	Desirable 32-45°
Peaches	Sort damaged fruit. Precool before packaging. Avoid bruising, moisture.	Tray overwrap	300 LSAT	Essential	Desirable 32-45°

TABLE 5, continued

Item	Preparation	Type Package	Film	Ventilation	Refrigeration
Pears	Remove damaged, overripe fruit. Keep dry. Sell only ripe pears. Handle carefully	Tray overwrap	300 LSAT	Essential	Desirable 32-45°
Plums	Remove damaged, shriveled fruit. Keep dry. Handle carefully	Tray overwrap	300 LSAT	Essential	Desirable 32-45°
		Bag	450 LSAT		
Tangerines	Remove damaged, moldy fruit.	Bag	450 LSAT (150 Polythene for 3 lbs. and over	Essential (for Polythene bag-$32\frac{1}{4}$" holes)	Desirable 32-45°

300 is a lighter film than the 450 gauge.

Polythene is du Pont's trade name for Polyethylene film; 150 is the gauge.

CA-Cellulose Acetate film; 43 is the rigid type, and 48 is the flexible type.

CHAPTER VI

EQUIPMENT, LAYOUT, AND TECHNOLOGY

Equipment

The introduction of prepackaged produce to self-service markets brought with it an immediate demand for packaging machinery and equipment especially designed for this work. So, necessarily, the first prepackaging machinery was that of existing machines made over or arranged for special attachments.

However, before long the packaging machinery manufacturers started working on new machines that would be designed specially for produce packaging. Today, the trend is toward specialty machines for particular items, because produce items are so many and varied that no one machine can meet all of the requirements.

The first item to be successfully handled by machinery was tomatoes. There are a number of different makes of machines available to do this job, covering a range of speeds and prices to meet almost any requirements.

The method of tray overwrapping used for tomatoes offered a means of automatic packaging for a number of other items too, but the standard machine used for wrapping tomatoes could not handle the larger items. Thus, it became necessary for the machinery manufacturers to develop models of their machines especially adapted to meet these requirements.

Wrapping Equipment

Generally speaking, all produce items can now be wrapped on present day wrapping machines. Some of these machines are semi-automatic, while others used by the large packers are completely automatic. A self-

measuring paper feed is standard equipment on some of these; this makes possible the wrapping of packages of various sizes and shapes. Whether the packages are level with the sides of the tray or heaped above them, an equally perfect wrap is assured because the overall bulk of each package determines the length of the sheet that is cut from the roll.

Also, most of the tray overwrapping machines can be obtained with labeling attachments. These attachments are usually provided with easily changeable type for printing such things as name, price and date. Other machines accomplish the same thing with printed bands. When perforating is necessary, perforated rolls may be purchased, or the wrapping machine may be equipped with perforators.

There are a few machines that will perform the wrapping operation without the use of a supporting container. In other words, the wrapping film is applied directly to the produce, forming a tight, heat-sealed package with maximum visibility. However, most machines require the use of cardboard forms that serve as a support against which the wrapper can be formed and sealed by the machine. These forms also give protection to the article. There are various kinds of forms that may be used, the simplest being the flat card, and the most complex being the window carton. The type to be used depends on the protection needed, and the machine. There are also tray set-up machines that should be synchronized with the wrapping machines.

Machine wrapping can be roughly divided into six stages:

1. Hand wrapping using a "sheeter-gluer" machine that cuts the wrapping material from a roll to the desired length and places the glue lines on the sheet if a nonheat-sealing wrapping material is used. Then the

wrapping and sealing is done by an operator using hand irons or table-type hot plates.

2. Hand wrapping with table fixture using pre-cut sheets with the operator making the first fold. The operator then places the package in the fixture. Every time a package is placed in the fixture, the preceding units are pushed forward manually through the fixture where the other folds and seals are made, completing the process.

3. Semi-automatic machine wrapping using pre-cut sheets with the operator making the first fold and then placing the package in the machine where the rest of the folds and seals are made automatically when the operator steps on a foot pedal.

4. Semi-automatic machine wrapping with the sheet being automatically cut from a roll, formed around the package, with the folds and seals made on all but one side. This open side is closed and sealed by hand on the end of the machine.

5. Fully automatic machine wrapping (medium speed) with the folds and seals made on the bottom or bottom and two sides. The bottom fold or underlap fold is the result of the package traveling up on an elevator and striking the wrapper which is fed in horizontally from the side of the machine. Elevator-type machines are very flexible and can be changed-over in a few minutes.

6. Fully automatic machine wrapping (high speed) with the folds and seals made on three sides of the package. This fold results from the package plowing through the wrapper which is fed in vertically from overhead.[1]

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1 W. B. Bronader. Wrapping Equipment. Modern Packaging Encyclopedia. 1950, pp. 656-658.

Bag Filling, Sealing and Closing Equipment

All of the operations necessary for bag filling, sealing and closing can be performed by automatic machinery, but the problem has not yet been completely solved. These machines operate by either measuring the produce volumetrically or net weigh it, and then discharge it through a loading chute into the bag. The bagging of apples and citrus fruit by machine is becoming very popular, but the majority of spinach and similar items are being bagged with the aid of simple loading funnels.

Rotary bag-sealing equipment has met with great demand because of its high productive capacity and the simplicity of operation. This kind of equipment can be used in conjunction with bag-filling machines, which makes for a minimum loss of production speed.

The rotary sealing machines may also be used along with belt conveyors for maximum utilization of its capacity. In many cases there are no operators required. These machines can be had in models adaptable to the requirements of all materials, whether they are glue-sealed or heat-sealed. Stapling, stitching and tying equipment may also be used in the bag-closing process.

Some concerns that package their products have found it profitable to install bag making machines in their own plants. Most of these machines are completely automatic and very flexible in the sizes of bags that can be manufactured. Thus, flexibility of quick change to suit marketing conditions is obtained, which materially cuts down the time of getting the new bagged item on the market or changing the size of the staple bagged item.

Attachments are also available for these machines that will automatically print information such as the contents, weight, price, or date of

package during the bag-making operation. Labeling the bags during manufacturing can be done in roll form, with die-cut labels, or by the use of of headers which are automatically fed into position over the top of the bag. Perforating machines, too, are available for use with these machines.

Other Equipment

In addition to the automatic machines already described, there are a great many auxiliary apparatus such as the shredder, dicer and corer equipment used in preparing vegetables for cole slaw, salad mix and soup greens. Then there are trimming tables and scales, washing tanks, laundry type extractors to dry the produce and shakers to separate undersize pieces and dry the produce. There is also equipment for removal of tissue wraps by suction, and for garbage disposal. Walk-in coolers are always important, and ripening rooms are essential for some commodities. Finally, conveyors are important in the overall operation. They can be used for many different purposes.

Plant Layout

The great sales appeal of prepackaged produce has caused many operators to rush into it without a thorough understanding of the proper approach to the problem. They thought that all they had to do was to buy some rolls of transparent film, wrap the produce in it, and open the doors for business. This attitude has resulted in high costs and business failures.

Prepackaging, like any other successful venture, must be taken seriously. It requires a specialized "know-how" which can be gained mainly from manufacturing fields rather than from merchandising. There are basic principles

to be followed in handling various operations which are applicable to all fields, whether it be harvesting vegetables or weighing and labeling them.

Proper planning and layout is one of the best means of eliminating unnecessary expense, and wasted time and motion. A good layout gets the greatest productivity per man hour and decreases handling costs. For example, the use of weighing scales which are flush with the table saves time and energy inasmuch as the weigher does not have to lift every item that is weighed.

From an industrial engineering standpoint, a good layout is just as essential as the plant equipment. In fact, industrial engineers call it the biggest piece of plant equipment.

Layouts usually fall into two basic types: (1) Product or line layout, and (2) the process or functional layout. In the line layout, equipment is arranged in a straight line along the path that the product travels, and each product is processed on a different line. In the process or functional layout, similar operations such as trimming, weighing and wrapping are grouped together in departments. There is no separation of products, and the same operation handles various products. This layout is most advantageous when there are a large number of items which need to be processed in a different manner, and the operation is intermittent and subject to large fluctuation in demand.

As the work is done, it is very important that the operations be synchronized. In other words, everybody should be working at the same time, and there should be no waiting. A good layout provides for adequate work stations during peak operations and gives maximum line balance at the same

time. Motion and time study are the techniques used to analyze work methods so as to attain the best arrangement.[1]

Following is a general outline that should be considered as an approach to improving handling and prepackaging methods:

I. Study the product and all of its characteristics, and consider

   A. The necessity of changing its condition by such means as washing, trimming, curing or ripening.

   B. The importance of color and appearance.

   C. The reactions of the product to temperature, humidity, light, atmosphere, et cetera.

   D. Its susceptibility to damage or deterioration which will be encountered during the marketing process.

   E. The time element, which is necessary for peak quality.

II. Analyze market requirements and define the objective, by determining

   A. The state of product desired when it leaves the prepackaging plant.

   B. The most desirable package size from the consumer sale standpoint.

   C. The maximum time necessary for processing, distribution and retail sale.

   D. The maximum quantities to be handled per day, based on potential market, receiving and shipping schedules.

III. Determine or develop the best process, handling methods and plant layout, which will produce the desired objective in the most efficient and economical way.

   A. Provide suitable space for carrying out the process or operation decided upon.

      1. Space and capacities are determined by the maximum output desired and size of inventory required to maintain this output.

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1 Rudolph Schwartz. Plant Layout for Prepackaging Plants. Pre-Pack-Age. November, 1949, pp. 24-26.

2. Determine the cost of the space.

3. Allocate the space for specific purposes.

4. Utilize the space as effectively as possible.

B. Combine processing operations and processing operations with movement wherever possible.

C. Obtain a smooth flow of materials by eliminating

1. Conjested areas and bottlenecks.

2. Back tracking and double handling.

3. Crossing and interference of flow lines.

D. Utilize man and machine time more efficiently.

1. Schedule and coordinate handling and transporting operations.

2. Improve communication systems.

3. Simplify complex sequences or operation.

a. When possible use the principle of one man to each motion or operation.

b. Develop specialists for each important motion or operation.

4. Provide trained personnel through progressive training programs.

E. Investigate all processing and handling equipment available for each operation and select the best combination.

1. When manual methods are necessary, utilize them to the best advantage.

2. Utilize mechanical and electrical means to the greatest extent consistent with overall requirements.

IV. Select, find or construct a suitable building to house the operations contemplated as dictated by the foregoing outline.

A. The location should be selected after considering

1. Availability of raw product.

2. Location of markets or outlets.

3. Labor supply.

4. Receiving and shipping facilities.

B. Analyze the building selected from the standpoint of

1. Plant layout.

2. Getting equipment in and out.

3. The operation as a whole (based on I, II, and III, above).

C. If it is impossible to find a building and location which meets all the requirements, it is often found advisable to build a new structure in a desirable location.[1]

Technology

The "will to live" in inanimate objects such as fruits and vegetables seems to be as strong as it is in the normal human being. If a human is deprived of an adequate food supply, he will continue to live for a while on stored-up body energy. When fruits or vegetables are removed from the soil or mother plant they are deprived of their food supply, but they too continue to live for a time by releasing their stored energy to maintain their life processes.

Unfavorable environments affect the life span of fruits and vegetables as they do human beings. Freezing temperatures can stop the living processes, and excessively high temperatures cause wilting. Dirt and filth result in disease and decay. Confinement in inadequately ventilated areas causes suffocation. Under all of these conditions, human beings and fruits and vegetables instinctively battle the environment to prolong life.[2]

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1 Frank A. L. Bloom. Plant Layout and Equipment for Prepackaging Fresh Fruits and Vegetables. The Bloom System, Inc., Detroit, Michigan. Mimeographed. 6 pp.

2 Walter A. Maclinn. Some Physiological Aspects of Produce Packaging. Pre-Pack-Age. November, 1949, p. 16.

However, if these produce items are given a favorable environment, they, as well as human beings, have a normal life span; and only in old age are there noticeable signs of withering, toughening and loss of what is known as vitality in man and quality in fruits and vegetables.

The decomposition of fruits and vegetables is caused mainly by two factors: (1) the destructive activity of certain bacteria present in the produce, (2) chemical changes that go on inside the fruits or vegetables. For instance, the oxygen in the air mixes with the plant tissues and forms waste products such as carbon dioxide which hasten decomposition.[1]

In order to bring about a favorable environment and reduce this decomposition, it is necessary to provide for: (1) proper care and handling, (2) sanitary environment, and (3) adequate protection.

Refrigeration

Refrigeration is the best means known of extending the shelf life of prepackaged produce, and its value cannot be overemphasized. However, not all produce items require the same degree of refrigeration. Bananas, tomatoes, sweet potatoes and a few other items require little refrigeration; while leafy vegetables, broccoli, cauliflower, carrots, sweet corn, beets and others retain their quality progressively better with the lowering of temperature down to 32 or 31 degrees Fahrenheit.

Refrigeration controls the growth of many decay producing microorganisms. This control is more important for prepackaged produce than it is for bulk because the relative humidity within the package becomes very high.

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1 M. M. Zimmerman. What's Ahead in Pre-Packaged Produce. Reprint from a series of four articles published in Super Market Merchandising. July, 1945 to October, 1945, p. 6.

This high humidity is beneficial in that it prevents loss of moisture and shriveling of the produce; but, on the other hand, it makes conditions better for the growth of these microorganisms.

Also, the heat units that are thrown off as plants respire can be greatly reduced with the use of refrigeration. This is important because the more energy that is given off in the form of heat, the faster the produce "burns up." Table 6 gives an idea of the amount of heat given off by the plants at different temperatures. It can be readily seen from this chart, that the lower the surrounding temperature, the fewer the heat units that are thrown off. For example, corn gives off only 9,390 units of heat at 40 degrees, but at 80 degrees it begins to burn up about seven times as much heat, thus decaying at a much faster rate.

Thorough refrigeration becomes a necessity when fresh produce is packaged at a considerable distance from the market and a transit period of from one to several days is required. The sooner the cooling is done after harvest, the better. Precooling, transport, warehouse and retail methods of refrigeration are all important.

Precooling. Rapid refrigeration of produce before shipment is called precooling. This is especially essential during warm weather. The success of maintaining quality control between the prepackaging plant and the stores depends, to a large extent, upon precooling. Precooling should be done before the produce is packaged because of the protection afforded by the package. For example, in a room where the temperature was 32 degrees Fahrenheit it took seven hours for the center beans of open packages of shelled limas to drop from 85 degrees to 40 degrees Fahrenheit. It took 11 hours for the beans to reach 40 degrees when the packages were sealed.

TABLE 6

WHY PRODUCE DECAYS [1]

Commodity	Temperature Fahrenheit	Heat Evaluations per Ton in 24 Hours - B.T.U.*
Apples	32	660 - 1,000
	40	1,100 - 1,760
	60	4,400 - 6,600
	85	6,600 -15,400
Bananas	54	9,240
	68	8,360
Beets	32	2,650
	40	4,060
	60	7,240
Carrots	32	2,130
	40	3,470
	60	8,080
Celery	32	2,820
	40	4,540
	60	13,520
Corn - G. B. Cross	40	9,390
	80	61,950
Grapefruit	32	460
	40	1,070
	60	2,770
	80	4,180
Lettuce	40	7,392 -15,990
	60	22,600 -45,980
Oranges	40	1,400
	60	2,900 - 5,000
	80	8,000
Peaches	40	2,030
	80	22,460
Strawberries	35	3,300
	40	6,600
	60	13,200 -15,400
	80	46,000 -46,440

*British thermal unit - The quanity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near its point of maximum density.

1 Loc. Cit.

The most common method of precooling vegetables for prepackaging is hydrocooling, and consists of moving the vegetables through refrigerated water. The water is either cooled with ice or with a mechanical system, and may be in a tank in which the produce is submerged, or the water may come from a sprinkler system and shower down over the produce while it is passing through a tunnel on a moving belt. If the water is kept at a temperature of about 35 degrees Fahrenheit, the warm vegetables will be cooled about 40 degrees in a 12 to 15-minute period.

While the produce is being packaged there may be a five to ten degree rise in temperature, but after packaging, the cartons containing the packages are usually placed immediately into cold storage or moved directly into precooled railroad cars where the temperature is again lowered.

Precooling grapes by means of cold air blast before the lids are put on the lugs is being done increasingly in California. This method accomplishes precooling without wetting the product. Ordinarily, satisfactory cooling to about 40 degrees may be accomplished in an hour if the air is sufficiently cooled. The air may be cooled in ice bunkers or by ice of mechanical systems.

A more recent development in precooling is by the use of a high vacuum method. Spectacular results are being obtained with certain crops. This method, along with the cold air method, offers an advantage for prepackagers in that rapid precooling may be obtained of the product in the package.

The produce to be cooled is placed in a sealed chamber, and a vacuum is created by withdrawing air and water vapor from the chamber. The rapid vaporization of water from the produce caused by the vacuum lowers the temperature in a relatively short time.[1]

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1 H. A. Schomer. Refrigeration of Prepackaged Produce. Pre-Pack-Age. November, 1949, p. 28.

Refrigeration in transit. Precooling is a very necessary step in the refrigeration which should be supplied in the interval from the packer to the consumer, but it is only the first step. Proper refrigeration in transit and in the marketing channels is important, too.

The Western Growers Research Institution of California proved that present railroad cars could hold the low temperatures brought about by precooling reasonably well by the use of bunker ice only - no ice added in the car or in packages. They arrived at this conclusion after shipping five carloads of fresh produce from California to states east of the Mississippi River. Arrival temperatures of three carloads were about 36 degrees Fahrenheit, and the other two loads were only slightly higher.

The refrigeration equipment in trucks is not standardized to the extent that it is in railroad cars. Most of the refrigerated trucks have an ice bunker in front of the truck body which may hold up to a ton of ice, usually with a small gasoline motor installed outside the bunker which drives a fan that blows air through the ice and over the top of the load. Generally, the quantity of ice used and the fan capacity are inadequate.

Mechanical refrigeration units are being installed in an increasing number of trucks, but many of these are too small to maintain a desirable temperature in truck loads also. However, some trucks are now being equipped with larger mechanical units which may have the capacity to cool loads in transit in addition to holding them at the proper temperature. When these units are perfected, considerable time will be saved since cooling may be done while the produce is being taken to market.

There is also a comparatively new method for preserving prepackaged produce, when it is shipped in unrefrigerated trucks, that has been developed

by the Union Bag and Paper Corporation. After much research and experimenting in an effort to find an economical and efficient method of refrigerating the produce during transit, the company has finally developed a specially constructed ice bag.

These bags are made with 50-pound kraft paper and are coated with polyethylene on the inside of the sheet. They are filled with five pounds of hydro ice and heatsealed. Then, the bag is placed in a master carton between layers of the produce.

The ice melts eventually, but the water does not leak out and continues to absorb the heat from the produce. Also, the water can be frozen again in the retail store and used on the produce counters with packages displayed on top of them where there are no refrigerated cases.[1]

Air cargo may come into prominence in the future, but the results of a study made by Dr. Spencer A. Larsen of Wayne University tend to confirm the opinion that this type of accomplishment is still a long way off. The rates at the present time are much too high, and even if they are lowered considerably it is doubtful whether they will be a competitive threat to the railroads except in the case of goods that the railroads cannot move efficiently. However, prepackaged produce offers a much greater possibility for future air transportation because much of the weight and bulk that is inherent in the shipment of bulk produce is eliminated.

Refrigeration in terminal markets. The refrigeration facilities and handling equipment in the terminal markets will vary with each warehouse

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1 Anon. Packaged Ice Preserves Prepackaged Produce. Wholesale Grocer News. December, 1950, p. 23.

and with many of the stores served by each warehouse. Most of the warehouses are equipped with cold storage rooms, but this space usually is inadequate, especially in warm weather.

There are no figures available as to the number of insulated, non-insulated or refrigerated trucks, but there are not too many equipped with facilities for refrigeration. Then too, these trucks usually make their deliveries at night; and the produce remains unrefrigerated until the store personnel arrive in the morning, except in the minority of cases when the produce is placed in the cooler upon delivery.

However, the ice bag or use of crushed ice over the packages is beginning to become popular in warehouse distribution. At the present time these methods appear to be the most effective means of refrigerating highly perishable prepackaged produce since they give continuous refrigeration.

In the retail store, the evolution of the modern open type refrigerated display case has been of considerable benefit to the retailer. These cases permit the use of mass displays and render efficient refrigerated protection to the merchandise. The cost of electricity for operating such a case ten feet in length, double duty type, runs between 12 and 15 dollars a month. The cost of the equipment itself varies, but a good estimate would be somewhere around $125.00 per foot, which includes the mechanical refrigeration unit.

On the other hand, the savings have to be considered through the use of such equipment. Government surveys show that the cost of equipment and maintenance, in addition to the cost of operation amounts to somewhere between 1½ and 2 percent of gross sales; while the same cases can reduce produce loss in the retail store by 4.2 percent of volume. This indicates that it actually costs about 2 percent less to operate a produce department

with proper refrigerated equipment than without. Also, there are labor savings because the produce does not have to be unloaded and placed in the cooler every night.[1]

Germicidal Treatment of Fresh Produce

Produce is delicate and, therefore, there are a large number of somewhat complex problems involved in the processing and handling of it. Freshly picked fruits and vegetables are living organisms which have been placed in an unfavorable environment; and any handling or treatment, regardless of how gentle it is, will have some injurious effect. Therefore, the problem is to accomplish the desired results with the least injurious treatment. With a greatly expanding prepackaging industry, these problems are especially complicated. The process of prepackaging involves a lot of handling which decreases the life of the produce at the very time when increased shelf life has increased importance.

There are several ways in which washing can be deleterious to the life of the produce. In the first place, the wash water may become contaminated from the decayed material that is always present and cause infection of the good produce. Then too, the produce is thoroughly saturated and kept moist, which increases certain types of decay. Also the natural waxes which provide a protective coating on most crops are partially removed by washing, making the item more susceptible to infection.

Making the wash water germicidal can produce two beneficial effects. First, it can keep down the bacterial count in the wash water which, in

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1 Anon. Refrigeration from Prepackaging Plant to Store. Pre-Pack-Age. April, 1951, pp. 25-28.

turn, will prevent the count on the produce from increasing. Second, the introduction of the germicide can reduce the number of infective organisms that were contained in the original produce. This could offset the disadvantages of wetting and slow up the decay process.

Bacteria are continuously introduced into the wash water from the produce that is being washed; partially decayed or heavily infected leaves inject a particularly large quantity. The number of bacteria in the water at any given time depends on the rate that the produce is put through the washer as compared with the rate that fresh water is added. The big problem is to obtain a bacteria-killing bactericide that will do the job without the necessity of using unduly high concentrations, rather than that of using a bacteriostatic agent to prevent bacteria multiplication, because the growth of bacteria in the wash is a slow process and of minor importance.

In addition to the bacteria that are introduced into the wash water, there are other organic debris that are continually contaminating it; the treatment must, therefore, be such as to remain active in the presence of this material. Also, there must be a wide enough margin between the concentration needed to produce the desired germicidal effect and that which would injure the plants. Finally, there are the obvious requirements of freedom from toxicity, lack of odor and freedom from corrosive action.

Only certain types of bacteria cause decay, and these are in the minority; but any process which decreases the total count should decrease the dangerous types accordingly and slow up the decay rate. However, the necessarily short duration of the washing process, and the protection afforded the organisms by most produce items, make even a small reduction difficult. The germicide used should penetrate into the cavities of the

article, and it should provide rapid germicidal action that will continue for a while after the produce is removed from the washing solution.

After many trials and tests, it has been found that active chlorine comes the closest to meeting the necessary requirements. Chlorine is unique in the degree of germicidal action shown at very low concentrations, in the speed of sterilization, in its activity against all types of organisms, in freedom from toxicity, in the readiness with which residual material left on the produce is converted back to neutral inorganic compounds and in the many methods of modifying its action. In order to use chlorine to the best advantage, though, it is advisable to modify the washing solution with suitable buffers and other added agents.

Small-scale laboratory washing of spinach with modified chlorine solutions in which the spinach leaves were washed, dried and packed in cellophane bags, and stored at room temperature, showed that the treatment is noticeable after 36 hours. The shelf life has been increased from approximately 36 hours to between 48 and 65 hours on the average.

Other tests on spinach based on a commercial washing operation show that the longer the storage period, the more noticeable the beneficial effects of the germicidal treatment.

Another crop that is now being commercially treated with much success in a prepackaging operation is celery. The shelf life has been increased in this case, also. An increasing number of shippers are adopting the process.

The results on one type of vegetable cannot be carried over exactly to another. For example, the infecting agent may be a bacterium or a fungi, both of which there are many types. Therefore, the exact composition of

the solution and method of treatment should be different for each crop. There is also some evidence that some crops need to be treated close to the point of harvest if there is to be a beneficial effect. It has been shown that with tomatoes, for instance, the organisms become so entrenched during long periods of transit that no feasible subsequent treatment is likely to offer a satisfactory degree of control. For this reason treatment shortly after harvesting is the answer.

It can be said in conclusion, that some aspects of the germicidal treatment of fresh produce in places other than growing areas are still in the development stage. Also for some types of operation, the reduction of costs is necessary, while in other cases better results could be had by changing the exact method of treatment.[1]

Food Plant Sanitation

Plant sanitation is a special series of operations, quality control, equipment selection and maintenance and eternal vigilance, all based on a thorough knowledge of what to do, what to look for and, finally, what to do about it.

The main points to be covered in a plant sanitation program are: (1) water supply, (2) care and maintenance of plant and equipment (including proper equipment for the job), (3) sources of possible contamination to the product, (4) rodent and insect infestations, (5) waste disposal, (6) personal cleanliness, (7) general housekeeping and tidiness, and (8) supervision and inspection.

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1 Henry C. Marks. Germicidal Treatment of Fresh Produce. Pre-Pack-Age. November, 1949, pp. 22-24.

Contamination comes from many sources: the raw product, air, water, rodents and insects, human hands, containers and packages, equipment and packaging aids and soil. Thorough cleansing with pressure water sprays is often required to remove the soil, which contains many bacteria, yeasts and molds, from tomatoes, carrots and leafy vegetables - soaker-type washers are not enough.

The air is not a very important source of contamination except for the dust that it carries. A clean water supply is all that is needed to eliminate this source.

Rodents such as rats and mice are always a menace because they are carriers of filth.

Insects can be controlled by screening, prompt and periodic waste removal, aerosol or other effective spraying programs and careful washing, trimming and inspection of the food product during the entire packaging operation.

Adequate toilet and washroom facilities will go a long way in helping workers to maintain their personal cleanliness.

A clean, sound and honest product can only come from a clean, well ordered factory operated by satisfied men and women who take a personal interest in the product.

Supervision and inspection in a plant sanitation program is of great importance. Department foremen should be responsible for sanitation within their own departments. Clean-up crews should be made to feel that their job is one of the most important jobs in the plant and not just something that has to be done at the end of a shift. There should be a continuous clean-up of equipment in addition to the clean-up at the end of the shift.

For the noon or end of shift clean-up some general steps should be followed. They are as follows:

1. Dismantle the equipment as far as possible in the time allotted.

2. After the equipment is dismantled, wash off the bulk or gross debris using cold or warm water at 100 to 140 degrees Fahrenheit. When washing equipment, it is advisable to start at the beginning of the operation or at the top, and wash down. Brushes help dislodge food particles during the wash. After the equipment is clean, wash the floor and gutters to get the debris out of the plant.

3. Slime or deposits can be removed by using detergents, high pressure equipment, brushes or other methods. If detergents are used, they should be thoroughly washed from equipment surfaces before they are permitted to dry.

4. When the slime is removed and the equipment is physically and chemically clean, a bactericidal agent should be applied to the surface which the survey indicated needed such treatment.

5. After cleaning is complete, all equipment should be washed with water to remove any detergent or germicidal agents which may be left.

High pressure units have proven to be very efficient in the removal of tenacious deposits and slime, and also save time in cleaning.

Detergents are chemicals which, when added to water, increase its power to clean. The effectiveness of a detergent depends on its ability to dissolve or suspend the contaminating materials so they can be washed away. The wetting power of a detergent depends on its ability to lower the surface tension, or in other words, to increase the penetration or spreadability of the water films.

Alkaline deposits can be dissolved by treatment with acids, and acid deposits can be dissolved with alkalis.

Detergents have as their principal active ingredient one or more of the following: lye, phosphates, silicates or carbonates, and weak acids, and to some, is also added an organic wetting agent.

At least four different materials are used in food plants at the present time to attain germicidal action. They are: chlorine compounds, quaternary ammonium compounds, strongly alkaline detergents and hot water. Chlorine is probably the most widely used. Recommended chlorine residuals should be two to five parts per million, though for clean-up water, it may be ten to 15 parts per million. Quaternary ammonium compounds are complex organic chemicals and are comparatively new in the field of germicidal treatment. They are odorless, tasteless, non-toxic and non-corrosive. Strong alkalis will destroy bacteria and, therefore, when they are used as detergents, bactericidal action accompanies the cleaning. Hot water, above 170 degrees Fahrenheit, will destroy the vegetative forms of most bacteria and can be used as a germicide in this way. Germicides, such as chlorine and quaternary ammonium compounds, may be applied periodically or continuously, depending on the equipment to be treated and both methods are used extensively. Very satisfactory germicidal treatment is accomplished when the entire water supply is chlorinated because all water used has germicidal properties.

The periodic application of a germicide usually follows the clean-up operation, and generally speaking, much higher concentration (ten to 15 parts per million) are used for this type of application than with the

continuous treatment. The germicide should be applied only after physical cleanliness is complete because all germ-killing agents are hampered in their action by the presence of organic matter.[1]

1 Carl R. Fellers. Food Plant Sanitation. Pre-Pack-Age. November, 1949, pp. 26-27.

CHAPTER VII

COST STUDIES

A study of prepackaging would not be complete without including some cost studies so that a general picture might be had of the relative costs involved. These costs, of course, will vary from operation to operation, and the examples included in this chapter do not set forth dogmatic facts. It is, however, possible to see from these experiments how prepackaging compares with bulk merchandising in the overall scheme of things, and to get an idea of the material, labor, depreciation and spoilage costs involved in prepackaging and how they can be offset by other savings.

The Department of Agriculture and the American Stores Company[1]

The United States Department of Agriculture conducted a three-year study in conjunction with the American Stores Company (Kearny, New Jersey) to determine the economic possibilities of retailing prepackaged fresh fruits and vegetables. The following is an account of this experiment which took place from 1945 to 1948.

Centralized Warehouse Packaging

Prepackaging in the warehouse usually followed this procedure: The fresh produce was removed from the warehouse cold-storage box in the morning and placed on a conveyor where it was trimmed, graded and packed into different sizes and types of paperboard trays holding about one to two

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1 Donald R. Stokes. Pre-Packaging Conclusions. Reprint from Modern Packaging. July, 1948, 7 pp.

pounds of produce. The trays then moved forward on revolving belts into a packaging machine which automatically wrapped and heatsealed cellophane around them.

A label showing the brand name of the produce, a description of the contents, the price and a code number indicating the date of packaging was automatically attached to each package. Then, the packages were packed in shipping containers and moved into the cold-storage box on rollers, where they were assembled into lots for delivery to retail stores.

Another packaging line was used for the packaging of such items as tomatoes, lemons and limes into narrow trays or "boats" in a similar manner. Still another line was used for commodities that were packed in film bags. These were placed on a machine with an automatic conveyor and heatsealing device that closed the bag and attached the label. These finished packages were also placed into shipping containers and moved into the cold-storage box. Other specialized machinery and equipment were used for bagging such items as onions, potatoes and oranges and for husking and packaging sweet corn.

Detailed descriptions of the procedures and machinery used were omitted because the project was of an experimental nature, and it was thought that the packaging equipment and the various techniques used would soon become obsolete.

Cost of materials and labor. The cost of packaging materials, as was to be expected, varied considerably depending upon the type and size of package, kind of material used, et cetera. On the average, though, it amounted to approximately 1.5 cents per retail unit of one to two pounds of produce. This average included an allowance for costs of shipping

containers based on an average of at least three trips between the warehouse and the retail store.

The cost of packaging labor in the warehouse covered the assembling of the bulk produce in the prepackaging room; uncrating the merchandise and placing it on the conveyor line; sorting, trimming, and otherwise preparing the commodity for packaging; opening trays or bags and placing the produce in them; weighing the contents to assure the correct net weight; placing the prepackaged units into shipping containers on another conveyor for movement into the cold-storage warehouse and selecting the shipping containers to make up the orders for the retail stores. In addition to the direct labor needed on the production line, the services of a specialized supervisor were used to plan the production schedule and direct the activities of the packaging operations.

The cost of labor also varied considerably by type of produce and kind of package, but the average cost was about two cents per unit. The variance, of course, was a result of the amount of work required for preparing each product. For example, lemons involve a relatively low labor cost per package because they do not require trimming or other conditioning, are readily placed in the trays and are easily handled throughout the production line. Whereas items like green beans have a high labor cost per package because they usually have to be sorted, are more awkward to handle, and when tray packed they have to be "lined up" to get the proper overwrapping of the transparent film. The cost of labor for packaging specified commodities as measured by spot checks is given in Table 7.

TABLE 7

PACKAGING LABOR COSTS PER UNIT AND AS A PERCENT OF RETAIL PRICE FOR SPECIFIED ITEMS, AMERICAN STORES COMPANY, KEARNY, NEW JERSEY, 1946

Date Packaged	Item	Unit	Labor Cost per Package	Labor Cost As % of Retail Price
September 24	Apples	5's	1.6	6
October 31	Apples	4's	1.6	8
June 20	Apricots	1 lb.	1.6	6
September 24	Beans, green	1 lb.	4.1	27
September 25	Beans, green	1 lb.	3.2	21
October 30	Beans, green	1 lb.	2.8	19
November 6	Beans, green	1 lb.	3.7	15
September 24	Beans, lima	1 lb.	1.5	8
October 30	Beans, lima	1 lb.	1.7	9
June 20	Beans, wax	1 lb.	2.0	12
June 20	Carrots	1 lb.	2.0	17
October 21	Carrots	2 bunches	1.8	9
November 6	Carrots	2 bunches	2.3	12
June 24	Cherries	1 lb.	1.2	3
June 20	Celery hearts	2 bunches	1.4	6
September 24	Grapes, red	1 lb.	1.4	7
September 24	Grapes, white	1 lb. 2 ozs.	1.5	5
November 5	Lemons	6's	1.5	6
September 24	Lettuce	Each	1.5	9
October 30	Lettuce	Each	1.2	8
November 6	Lettuce	Each	1.2	6
October 30	Mixed fruit	5's	3.0	10
November 5	Mixed fruit	5's	2.0	7
September 24	Oranges	5-lb. bag	2.4	3
June 20	Oranges	8 pcs.	1.8	7
June 20	Onions	2 lbs.	1.0	6
November 5	Peas	1 lb.	1.1	4
September 24	Peaches	1 lb. 15 ozs.	1.5	8
September 25	Peaches	1 lb. 15 ozs.	1.2	7
September 24	Pears	4's	1.2	6
October 30	Pears	4's	1.6	6
November 5	Pears	4's	1.0	4
September 24	Peppers	1 lb.	2.1	21
October 31	Peppers	3's	1.6	10
November 6	Peppers	3's	1.5	9
June 20	Plums	1 lb.	2.7	6
June 21	Plums	1 lb.	3.3	9
September 24	Prunes, Ital.	2 lbs.	1.5	5
September 25	Prunes, Ital.	2 lbs.	1.6	6

The costs shown in this table will not reflect what the average packaging costs for these items would be over a much longer period. Other variables such as machinery breakdowns and experimental use of certain machinery, packing methods, et cetera, would tend to make the overall average production costs somewhat higher than those observed in a comparatively short survey such as this.

The labor cost per package is very important in determining which items can be prepackaged economically, but it is not the only consideration. The relation of the cost of packaging to the retail price of the package and to the gross margin is of equal importance. For example, cherry packaging at a labor cost of about two cents for a 49 cent package, or about 4 percent of the sales dollar, is much more practical than packaging a low-priced commodity like carrots. The cost of packaging carrots is about the same, but percentage-wise it is much greater. Also the relation of the cost of packaging to the normal gross margin available when the commodity is handled in bulk and to the relative saleability of the commodity when sold in bulk and prepackaged is very important. Although even when items such as string beans are relatively costly to prepackage, the job might still be found to be worth-while. Time studies made in retail stores showed that the cost of retail labor in bagging, weighing and pricing the beans in the store often exceeded centralized packaging labor costs.

The centralized labor costs are, of course, influenced a great deal by the efficiency of the equipment which is used, while machinery breakdowns, et cetera, would tend to raise production costs in the long run. Improvements in design of packaging machinery, conveyor systems, et cetera, will help to lower these production costs. Also specialization of machinery

would save time and money. For example, the packaging of eight items on eight packaging lines would be much more efficient that prepackaging eight items on one line because no changes would be necessary.

The quality of the labor, the rate of labor turnover and the general wage level for unskilled labor also help to decide the labor costs. Labor productivity should increase as improved skills are gained through practice on the job as well as with technological advances in machinery and equipment.

Retail Aspects

Losses through waste and spoilage. The additional costs of packaging, including material and labor, usually are met through reductions of waste and spoilage as well as through reduced labor costs in the retail stores. The average rate of spoilage on prepackaged refrigerated items was 2.5 percent of the value of the produce handled, in comparison with an average rate of 6.2 percent of the value of the produce handled in the bulk non-refrigerated stores. Many of the commodities that were prepackaged were also sold in bulk in the so-called prepackage stores. The average spoilage rate on these items handled in bulk and refrigerated was 4.2 percent.

Retail labor costs. The sales per man-hour in the retail stores varied with the amount of produce that was prepackaged. When fewer items were prepackaged because of high costs, the proportion of bulk-produce sales in the prepackage stores increased, accompanied by a drop in the value of sales per man-hour.

The retail labor costs, as a percentage of dollar sales, did not show the reductions that were expected. When very close administrative attention was being paid to the wage percentage, a full 3 percent saving was

realised in the prepackage stores as compared to the bulk-store performance. However, on the average a saving of less than 2 percent was made. These percentages did not include check-out labor.

Observations made in regard to the time entirely lost by retail produce clerks during intervals between waiting on customers showed that the average weekly man-hours lost completely while waiting for trade were 1.5 per week in the prepackage stores compared with 7.9 in the bulk stores. This lost time was reflected in the higher wage percentage found in the bulk stores.

Relative profit, prepackaged and bulk. A comparison of the percent of net profit was made between the produce departments from which prepackaged produce was sold and produce departments handling only bulk produce. Retail prices were the same for bulk and prepackaged produce, which resulted in the original gross margin always being lower in the produce departments of the prepackage stores. The original gross margin (before waste and spoilage losses) for produce handled in the prepackage stores averaged about 4 percent less than in the bulk stores. After costs of waste and spoilage and unseen shrinkage were accounted for, though, the final gross margin was only around 2 percent lower in the prepackage stores. This 2 percent difference was largely offset by increased labor efficiency in the store, so the net profit in the prepackage stores, as a percentage of the sales dollar, actually averaged about the same as that in the bulk stores.

In arriving at this comparison of net profits, additional costs involved in prepackaging produce - including packaging materials, packaging labor,

warehousing, refrigeration and supervision - have been charged to the prepackaged produce. Depreciation costs on the packaging machinery were not included because a lot of this equipment was custom built and the actual cost was too high to be a realistic indication of long-time costs. Trade estimates of the cost of depreciation and maintenance of packaging machinery and equipment ran from three-fourths to 1¼ percent of the retail value of the produce packaged.

The Purdue University Experiment[1]

This study was made by the Department of Horticulture of the Purdue Agricultural Experiment Station in cooperation with the Minardo Brothers Fruit Company of Lafayette, Indiana. Various fruits and vegetables were prepackaged in this experiment.

The Packaging Process

The process of packaging included preparation, packaging and wrapping. Preparation involved washing, sorting, trimming, drying and, in some cases, waxing. Packaging involved two main operations - weighing and placing the products in the cartons. The time spent in weighing the different items was influenced by the initial cost of the produce; the lower the cost, the less attention paid to a slight overweight. This enabled the weighing operation to be done more quickly. The wrapping operation consisted of placing a semi-moisture proof, heatsealing overwrap around the package by hand and then placing it in a semi-automatic wrapping machine which com-

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1 F. C. Gaylord, et al. Packaging Fruits and Vegetables - Cost, Palatability and Consumer Acceptance. Purdue University and Agricultural Experiment Station, Bulletin 530. 1948, pp. 6-14.

pleted the job of wrapping and sealing; or in the case of popcorn, oranges and cranberries the items were packaged in cellophane bags which necessitated sealing or stapling. The heatsealing device and the stapler were not as efficient as the machine used for wrapping the cartons, and the wrapping costs were excessive compared to those on other products.

Labor costs. The total cost of packaging fresh fruits and vegetables involves labor and material costs. These costs are shown in Table 8. The labor used in the packaging operations was paid 60 cents per hour. These costs were computed on the actual time spent on the different operations. Usually two, and occasionally three and four women were employed and they all worked at the various operations. This probably raised the costs because they did not become experts in any one operation, but the relationship in the costs between the different operations can still be compared.

Labor accounted for 61 percent of the total packaging costs. It included washing, waxing, sorting, weighing and packaging. The labor costs ranged from one cent for lemons up to six cents per package for spinach. Tomatoes, popcorn and cranberries required less labor to package than did cauliflower, sweet corn and salad. Most of the labor involved in sweet corn and salad was spent in preparing. The high cost of packaging oranges (4.5 cents) was due to the fact that they had to be fitted into the cellophane bags.

Material costs. The packaging materials consisted of cartons, overwraps and cellophane bags, their cost amounted to 39 percent of the total packaging costs. This was practically a fixed cost and could not be materially reduced, but it could be minimized by using the same size of container

TABLE 8

THE PERCENT OF LABOR INVOLVED, THE PACKAGING COSTS AND THE PACKAGING LOSSES IN FRUITS AND VEGETABLES

Product	Size of Package	Number Pkgs.	Percent of Labor: Prepare Percent	Package Percent	Wrap Percent	Packaging Costs Cents: Labor Cost	Carton Cost	Total Cost	% Loss Packing
Tomatoes	1 lb.	29,391	32	40	28	1.2	1.6	2.8	0
Popcorn	1½ lbs.	16,291	0	51	49	1.6	1.0	2.6	0
Cauliflower	1 lb.	14,094	38	50	12	3.2	1.6	4.8	70.0
Spinach	1 lb.	10,613	33	57	10	4.2	2.4	6.6	19.0
Cranberries	1 lb.	6,388	0	65	35	1.4	1.0	2.4	5.0*
Hd. lettuce	1 hd.	6,139	43	28	27	2.0	1.2	3.2	1.0
Salad Mix	1 lb.	5,205	55	32	13	3.9	1.6	5.5	0
Grapes	1 lb.	4,607	0	77	23	2.6	1.6	4.2	11.0
Oranges	16 & 20	3,600	0	61	39	4.5	2.6	7.1	6.0
Sweet Corn	4 ears	2,367	66	19	15	5.3	1.2	6.5	15.0
Carrots	1¼ lb.	1,806	24	51	19	2.5	1.6	4.1	0
Lemons	6	1,218	60	32	8	1.0	1.6	2.6	3.0
Peaches	2 lbs.	1,144	0	69	31	2.4	2.4	4.8	0
Green beans	2 lbs.	814	20	51	29	3.1	2.4	5.5	7.0*
Celery	1 stalk	519	60	32	8	2.8	1.6	4.4	0
Apples	3 lbs.	354	0	83	17	2.4	2.4	4.8	0
Endive	1 hd.	323	0	75	25	3.0	2.4	5.4	0
Potatoes	4 lbs.	322	19	49	32	3.6	2.4	6.0	0
Total, 18		105,195				50.7 (61%)	32.6 (39%)		

*Percent gain

for several products, which limited the necessity for special sizes which would be used only in limited quantities. Cranberries and popcorn were packaged in cellophane bags costing one cent each.

Product losses. In packaging fresh fruits and vegetables some loss is to be expected. The loss is determined partially by the condition and quality of the original product and by variations in net weight of the original products. The percent of packaging losses for the various products are shown in Table 8.

Green beans and cranberries showed a large overrun between the net weight of the produce as purchased and the amount packaged. This overrun offset any loss and, in fact, produced a gain.

Apples and peaches showed no loss because most of them were sorted at the orchard for packaging sizes and quality. If this fruit had been purchased on the open market, losses would have occurred, because it would not have been graded so closely.

Carrots that lacked the necessary quality for packaging were sold in bulk or prepared for mixed salad. Trimmings from the celery were also used in making this salad.

The greatest losses occurred in spinach, sweet corn and grapes. Spinach shipped in from a distance showed more loss than the home grown variety because in some cases heavy bruising occurred and in others it had become water soaked and soon went to pieces. Corn ear worm and poor pollination caused some of the loss in sweet corn, but this loss was reduced by packaging well filled and trimmed half ears, two and sometimes four halves to the carton. Several of these packages were included in each order.

When packaging white grapes they shattered badly, causing a higher packaging loss than either the red or black varieties. The one percent

loss of head lettuce represented a head loss rather than a trimming loss since some outside leaves are always removed. Tomato losses were 7 percent and were caused by decay, poor color and cracking, with decay being the main cause.

The heavy loss in cauliflower was a trimming loss; when the weight of the packaged product was compared with the original net weight there was an average loss of 70 percent. It ranged from 41 to 80 percent in crated cauliflower. The disposal of this refuse is expensive and bothersome.

Prepackaging Cranberries Cooperatively[1]

The Cooperative Research and Service Division of the United States Department of Agriculture made this study, which sets forth some comparative cost figures for prepackaging and bulk packaging of cranberries. It aims also to point out certain factors affecting the efficiency of the prepackaging operation and related problems.

The study is based on an analysis of the comparative packaging costs reported by a number of associations for the 1948 cranberry crop. Its aims are merely to estimate the additional expense of packaging cranberries in one-pound containers over that of quarter-barrel boxes after the berries have been screened and graded.

For this purpose four cost factors were considered; namely, unit containers, carrier cases, prepackaging labor and equipment depreciation. Sometimes it was difficult to determine the exact cost from the existing records. Frequently the accounts made no provision for separate records.

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1 Oscar R. Le Beau. Prepackaging Cranberries Cooperatively. Cooperative Research and Service Division, Farm Credit Administration, Washington, D. C., Miscellaneous Report 138. May, 1950, pp. 9-17 and 19-21.

Where this was the case, it was necessary to rely on the best estimates available from the plant foreman and others familiar with the actual operations.

The equipment depreciation costs are based on a flat 10 percent of the value of the equipment. The average depreciation cost per case was estimated by dividing the total calculated depreciation by the number of cases packed by the respective types of machines. When calculated in this way, the average depreciation costs per case for the large machines amounts to less than twice that of the smaller machines being used, whereas the actual investment in a large machine usually amounts to about five times that of the smaller machine.

Some of the associations in the study were packaging cranberries in cellophane for the first time. Greater efficiency will probably occur as these packers gain in experience and as the volume packed in cellophane increases. Also, the shift to cellophane was so rapid that some of the packing houses had to use temporarily the best make-shift facilities possible. Some of these conditions have since been improved with resultant savings in labor and other costs.

Comparative Costs of Packaging in Cellophane and in Bulk

The successful prepackaging of cranberries in one-pound containers requires additional equipment, labor and containers. The expenditures for these items vary from plant to plant, depending on the volume packed and the general efficiency of the operation.

This study is concerned only with comparing the costs of filling, closing and stacking quarter-barrel boxes and 24 one-pound bag cartons

after the berries are ready for packaging. The cost of warehousing, screening and preparing the cranberries for packaging is theoretically the same for all types of packages. Table 9 summarizes the comparative costs of packaging fresh cranberries in cellophane bags and in bulk.

TABLE 9

COST OF PACKAGING FRESH CRANBERRIES BY TYPE OF PACKAGE, 1948-49*

	Case of 24 1-lb. Bags	Wooden Box of 25-lbs. bulk	Difference
Cellophane bags	31.5	-	31.5
Carrier case	17.0	-	17.0
Wooden box	-	47.5	-47.5
Packaging labor	7.0	3.4	3.6
Equipment depreciation	1.3	.1	1.2
Total	56.8	51.0	5.8

*Based on cost data for 437,921 cases packed in cellophane and 308,639 quarter-barrels packed in wood.

According to Table 9, it cost a few cents more to pack cranberries in a case of 24 one-pound bags than in a quarter-barrel box. However, the difference of 5.8 cents was nearly offset by the elimination of the quarter-barrel wooden box. It was expected that with an increase in volume and efficiency, the difference would be even less.

Cost of cellophane. The cost of cellophane averaged 31.5 cents per case of 24 bags for the quantity included in this study. The average price by associations was as low as 24 cents to as high as 35.4 cents per case. The packers who purchased their cellophane in rolls had lower film costs than those using ready-made bags.

Cost of carrier cases. A corrugated cardboard carrier case holding 24 one-pound bags was usually used for shipping the cranberries. The bags were packed three layers deep, eight to the layer. The average cost of these cases was 17 cents. The lowest cost was 16 cents and the highest, 25.6 cents. The differences in cost were due mostly to a difference in the cases used.

A short time ago a number of the cranberry prepackers were using heavy, liberal-sized cases that were quite expensive; but when it was demonstrated that a smaller, more economical case would give adequate protection, most shippers adopted the lower priced case. By doing so, they have saved themselves as much as ten cents or more per case shipped. This will result in a large saving to both growers and consumers over the years.

Cost of quarter-barrel boxes. A major cost involved when cranberries are packaged in bulk is the price of the wooden box used for this purpose. This box holds from 23 to 26 pounds of cranberries, depending on the size, quality and variety of berries packed. The cost of these boxes ranged from 47 cents to 50 cents in this study, depending on the date purchased and the amount of transportation and handling charges involved; the average cost was 47.5 cents. This average cost was about the same as the combined cost of the cellophane and carrier case used for prepackaged cranberries, (48.5 cents).

Cost of packaging labor. Another important item to be considered in comparing packaging costs is that of labor. The amount of labor needed is tied in closely with the plant arrangement and with the amount of labor-saving equipment used.

Table 9 shows the average labor cost for packaging a case of 24 one-pound units to be seven cents as compared to 3.4 cents for a quarter-barrel box. So for the quantities studied, prepackaging required about twice as much labor as did packaging in bulk. However, the man hours required for bulk packaging were stabilized over the years. The next few years will probably see a considerable reduction in the man hours needed for prepackaging also.

The labor costs for prepackaging in cellophane ran from 4.4 cents to ten cents per case, depending mostly on the type and adequacy of the equipment used. The higher costs were the result of some inefficient procedures which were due to the rapid shift from bulk packaging to prepackaging by some of the packers.

Equipment depreciation. The depreciation cost per quarter-barrel packed amounted to an average of less than 0.1 cents for berries packed in bulk to 1.3 cents for those packed in one-pound bags. It required about 1.2 cents more per quarter-barrel unit to write off the cost of packaging equipment for prepackaged cranberries than for the bulk berries. The depreciation was calculated uniformly at ten percent of the quoted value.

The reason for this difference was the equipment used. Bulk packaging requires very little equipment. The wooden boxes are simply filled to capacity, and then lidded with a hand hammer and conveyed to cars or trucks by hand carts or mechanical conveyors. On the other hand, the packaging of cranberries in cellophane requires delicate weighing, filling and closing equipment. Also, for efficient operation, a mechanical conveyor system is usually desirable. The actual amount invested in equipment varies substantially with the type and size of the packaging operation.

Prepackaging cranberries in window cartons. The window carton was one of the first consumer-size packages used by cranberry packers, but it has never been as popular as the cellophane bag. One of the principal reasons for this has been its higher cost. Other reasons are the looseness of the pack, the limited visibility and the fact that the film on the windows cracked and the glued edges sometimes did not hold up.

The differential in price between the cellophane bag and the window carton has narrowed somewhat in recent years, however. For example, in Wisconsin, where the window box had its best reception, its reported cost in 1949-50 was 1.75 cents each or about 42 cents per case of 24 units. The cost of cellophane was 31.2 cents per case, which made a difference between cartons and cellophane of 10.8 cents per case of 24 units; while in 1948-49, the difference was 21.6 cents per case.

Of course, a complete comparison would have to take into consideration the labor costs involved in filling each of these two types of containers. The small quantity of berries packed in window cartons did not make it feasible to undertake an estimate, but this is bound to vary considerably. It is known, however, that the labor cost incurred in hand filling the cartons is higher than that involved in machine filling the ready-made transparent bags.

The shippers would need to receive about 15 cents more per case of 24 cartons than for a case of 24 cellophane bags in order to absorb the additional container and labor expense involved. The American Cranberry Exchange, for example, included a differential of this amount in its schedule of prices for September 10, 1949 - at the opening of the 1949-50 season. These quotations were: $3.00 per quarter-barrel box; $3.25 for

24 one-pound cellophane bags; and $3.40 for 24 one-pound window cartons. There was a general hesitancy on the part of buyers to pay any more for berries packaged in cartons than for berries packed in bags, when they were both obtainable. As a result, the tendency has been to lessen the differential and in some cases to offer both at the same price.

Prepackaging Apples at Point of Production[1]

This study was conducted by the Production and Marketing Administration of the United States Department of Agriculture in conjunction with the Washington State Apple Advertising Commission.

Costs of Bagging Apples

Costs of packaging apples varied with the method of filling the bags and the type of bag used. The extra cost per box of prepackaging apples as compared with that of packing them in the bulk containers (not counting overhead investment and depreciation of equipment) ranged from 26 to 32 cents on the four-pound attached printed header bag (attached cardboard type collars) and from 34 to 42 cents on the three-pound attached printed header bag, depending upon the method of packing that was used. The labor costs on many of the bagging operations were below those of the standard pack, but the additional cost of the bags made it more expensive to prepackage apples than to bulk pack them in boxes.

The size of the bag was an important consideration in the cost of prepackaging, because essentially the same motions were necessary in filling a

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1 Earl W. Carlson and Donald R. Stokes. Prepackaging Apples at Point of Production. Production and Marketing Administration, Agriculture Information Bulletin 29. January, 1951, pp. 28-29 and 41-50.

three-pound bag as a four-pound bag. Material cost was higher for small bags because more bags went into a carton and the difference in the price of bags in relation to their size was not large.

Costs of Retailing Prepackaged and Bulk Apples

Thirty-two store weeks of tests (three stores for four weeks each in Kansas City and Los Angeles and two stores for four weeks each in Chicago) were made in collecting data on labor costs, materials and spoilage in retailing the bulk and the prepackaged apples side by side. One full-time research worker was assigned to each of the test stores. During the first two-week period, three-pound bags and bulk apples were sold from the same lot and displayed next to each other, while the four-pound apples were sold along-side the bulk apples for the second two weeks. Price and displays were kept comparable, and no other Winesap apples were available for sale in these stores during the test period.

The time spent by retail clerks in building and maintaining the displays was obtained by direct observation and recorded by the use of a stop watch. The labor required to wait on apple customers and the amount of materials used for each purchase of apples were determined by recording the time it took to wait on the customer, the amount of her purchases and the size of the bag used. This information was collected on the majority of apple customers. The number of apple customers was found by dividing the total amount of fruit sold by the average size of sale observed in the sample.

The direct cost of retailing bulk apples, including waste and spoilage losses, labor and bagging materials, amounted to 43 cents for the daily

average sales of 46.7 pounds of bulk apples compared to 14 and 16 cents, respectively, for daily average sales of 58.6 pounds in three-pound bags and 60.5 pounds in four-pound bags (see Table 10). When these costs are converted to a standard box or carton basis, it can be seen that a retailer could pay about 26 to 27 cents more for prepackaged apples than for the standard-pack apples and still retail them at the same price. This 27-cent savings is made up of a savings of 12 cents on waste and spoilage, ten cents on labor and five cents on cost of kraft bags.

Spoilage costs. As shown in Table 10, the average spoilage and markdown loss was much greater on the bulk apples than on those in the three and four-pound bags, while the spoilage in the three-pound bags was about half as large as in the four-pound units. The only explanation for the greater spoilage in the four-pound units is that the tests were made about two weeks later than the three-pound tests on the average. This time difference could have caused the higher loss because of the increased storage period. However, some more research could be carried out along these lines.

Labor costs. Table 11 shows that the labor requirements for bulk-displayed apples averaged 17.1 minutes per hundredweight; three-pound bags required 7.9 minutes of labor per hundredweight; and four-pound bags took 5.3 minutes of labor per hundredweight. There was a noticeable difference in the amount of labor needed to maintain the displays; for instance, the bulk displays took twice as much labor as the four-pound units. In Chicago, one of the four-pound displays was moved and rebuilt three times during the test, which added to the labor time. In Los Angeles, more time was used in maintaining displays of four-pound bags than three-pound bags also. This was partly caused by the extra diligence exercised by one store in main-

TABLE 10

COMPARISON OF AVERAGE DAILY SALES AND DIRECT COSTS OF RETAILING BULK AND PREPACKAGED APPLES IN SELECTED STORES IN CHICAGO, KANSAS CITY AND LOS ANGELES, FEBRUARY-APRIL, 1950[1]

City and Unit of Sale	Retail Price per Pound	Quantity	Cost to Retailer	Sales		Cost of Spoilage Including Mark-Down	Spoilage As Percentage of Sales	Original Gross Margin[2]
	Dollars	Pounds	Dollars	Pounds	Dollars	Dollars	Percent	Dollars
Chicago (2 stores):								
Bulk (pound)	0.1250	24.9	2.05	24.6	3.08	0.04	1.3	1.03
Three-pound bag	.1250	47.9	4.63	47.6	5.95	.04	.7	1.32
Four-pound bag	.1225	50.7	4.70	50.6	6.20	.01	.1	1.50
Kansas City (3 stores):								
Bulk (pound)	.1266	30.7	3.03	29.8	3.77	.11	2.9	.74
Three-pound bag	.1298	63.5	6.37	63.2	8.20	.04	.5	1.83
Four-pound bag	.1225	79.6	7.55	78.5	9.62	.13	1.4	2.07
Los Angeles (3 stores):								
Bulk (Pound)	.1107	82.2	6.35	80.6	8.92	.18	2.0	2.57
Three-pound bag	.1120	59.9	5.41	59.7	6.69	.02	.3	1.28
Four-pound bag	.1091	47.0-	3.99	46.3	5.05	.08	1.6	1.06
All cities:								
Bulk (pound)	.1165	48.2	3.97	46.7	5.44	.17	3.1	1.47
Three-pound bag	.1213	58.6	5.56	58.4	7.08	.02	.3	1.52
Four-pound bag	.1185	60.5	5.54	59.8	7.09	.08	1.1	1.55

TABLE 10, continued

City and Unit of Sale	Retail Gross Margin As Percentage of Sales	Direct Labor Costs	Total Labor Costs As Percentage of Sales	Material Costs	Material Costs As Percent of Sales	Total Direct Costs of Retailing	Final Gross Margin[3]	Final Gross Margin As Percent of Sales
	Percent	Dollars	Percent	Dollars	Percent	Dollars	Dollars	Percent
Chicago (2 stores):								
Bulk (pound)	33.4	0.15	4.9	0.04	1.3	0.23	0.80	26.0
Three-pound bag	22.2	.11	1.8	.02	.3	.17	1.15	19.3
Four-pound bag	24.2	.10	1.6	0	0	.11	1.39	22.4
Kansas City (3 stores):								
Bulk (pound)	19.6	.16	4.2	.04	1.1	.31	.43	11.4
Three-pound bag	22.3	.12	1.5	0	0	.16	1.67	20.4
Four-pound bag	21.5	.09	.9	0	0	.22	1.85	19.2
Los Angeles (3 stores):								
Bulk (pound)	28.8	.27	3.0	.09	1.0	.54	2.03	22.8
Three-pound bag	19.1	.09	1.3	0	0	.11	1.17	17.5
Four-pound bag	21.0	.07	1.4	0	0	.15	.91	18.0
All cities:								
Bulk (pound)	27.0	.20	3.7	.06	1.1	.43	1.04	19.1
Three-pound bag	21.5	.11	1.6	.01	.1	.14	1.38	19.5
Four-pound bag	21.9	.08	1.1	0	0	.16	1.39	19.6

1 Duration of test was 4 weeks in each store - 2 weeks' test of bulk and 3-pound bagged apples and 2 weeks' test of bulk and 4-pound bagged apples.

2 Original gross margin (sometimes called mark-up). Retail sales value less cost of apples to retailer.

3 Final gross margin equals original gross margin or "mark-up" less direct costs of spoilage, labor and materials.

TABLE 11

TIME REQUIRED BY LABOR PER HUNDRED POUNDS OF APPLES HANDLED IN BULK AND IN THREE AND FOUR-POUND BAGS IN SELECTED STORES, SPRING OF 1950

City	Unit of Purchase	Time Required for			Total	Total Labor Cost	Labor Cost As A Percentage of Sales
		Preparing Display	Maintaining Display	Waiting on Customers			
		Minutes	Minutes	Minutes	Minutes	Dollars	Percent
Chicago	Bulk	5.8	7.6	12.5	25.9	0.60	4.9
	3-lb. bags	3.4	5.6	-	9.0	0.23	1.9
	4-lb. bags	3.4	6.1	-	9.5	.21	1.6
Kansas City	Bulk	4.3	13.1	10.5	27.9	.51	4.3
	3-lb. bags	2.8	6.9	-	9.7	.19	1.5
	4-lb. bags	.4	4.5	-	4.9	.11	0.9
Los Angeles	Bulk	1.4	6.7	3.0	11.0	.32	3.0
	3-lb. bags	1.6	3.6	-	5.2	.16	1.3
	4-lb. bags	.7	4.3	-	5.0	.15	1.4
Three cities	Bulk	2.6	8.5	6.0	17.1	.41	3.6
	3-lb. bags	2.5	5.4	-	7.9	.19	1.5
	4-lb. bags	1.0	4.3	-	5.3	.13	1.1

taining quality in the four-pound bags. The amount of labor necessary to prepare the prepackaged displays was further increased in Chicago because all of the bags were price-marked beforehand.

The gain in labor efficiency in the retailing of prepackaged apples is great, as shown in Table 11. It is due mostly to the savings in time spent in waiting on customers. The time spent in waiting on customers averaged six minutes per hundredweight of bulk fruit handled for the three markets, but was much lower in Los Angeles, where produce departments had their own check stands. However, the clerks in the Los Angeles areas usually used less time in all of their operations than those in the other areas. In Chicago the total cost of direct labor in retailing apples in bulk was 60 cents per hundredweight, which was almost twice as high as in Los Angeles.

Self-service merchandising helped to speed up store traffic, which is a big factor in the overall profit picture. The average customer in all of the stores took 35 seconds to select her apples from the bulk displays, and the average size of the purchase was 2.2 pounds. Less than half of this time was required for purchasing prepackaged apples. Approximately 14 seconds was needed to buy either a three or a four-pound bag.

Materials costs. Except for bag breakage, the cost of the prepackaging materials for the prepackaged apples is reflected in the price the retailer pays for the apples. The cost of materials to replace broken film bags is a negligible item. On the other hand, the cost of kraft paper bags to the retailer (about 1.3 cents per sales dollar for bulk apples) is another item of cost largely saved by handling prepackaged apples.

Costs of Marketing

Sales of prepackaged apples in the Pacific Northwest have not been extensive enough to establish a "market" for them. However, sales are generally made on the basis of the f.o.b. standard pack apple market price, with a provision made for the extra costs of packaging. These extra costs have been set at a figure that returns to growers the same amount for prepackaged apples as they would get if the fruit were sold in standard pack.

In the different markets the margins of prepackaged and bulk apples are, of course, different. The retailer's original gross margin or "mark-up" on the prepackaged apples were about 20 to 30 percent; but in some cases, when specials were run, they were as low as 10 percent.

The marketing costs and margins on prepackaged and bulk apples in Chicago and Los Angeles are shown in Table 12. The computations for returns in Kansas City were not set up similarly because of variability in practices among the independent merchants. These figures are based on actual costs and margins in test shipments, made for that purpose, representing sales for 20 store weeks. The 25-cent item for wholesaling is the figure the co-operators always used to cover their warehousing and distributing expenses.

These data show that the extra cost of prepackaging apples in attached header-type bags in comparison with the standard box pack is nearly offset by the savings realized in the retailing of the prepackaged apples. It was not known how representative the store in which the data were collected was of other food stores, but it seemed safe to conclude that somewhere between one-half and three-quarters of a cent additional cost per pound could be invested in prepackaging apples at point of shipment and still enable the retailer to sell them at prices comparable to those of bulk apples.

TABLE 12

MARKETING COSTS AND MARGINS ON PREPACKAGED AND BULK APPLES, AT RETAIL STORES, CHICAGO AND LOS ANGELES, 1950[1]

	CHICAGO			LOS ANGELES		
	Cartons of 14 Three-Pound Bags (42 Pounds)	Cartons of 11 Four-Pound Bags (44 Pounds)	Standard Pack (42 pounds)	Cartons of 14 Three-Pound Bags (42 Pounds)	Cartons of 11 Four-Pound Bags (44 Pounds)	Standard Pack (42 Pounds)
F.O.B. selling price (less packaging costs)	1.84	1.93	1.84	1.89	1.98	1.89
Packaging material costs	.81	.74	.44	.81	.73	.44
Packing labor	.11	.11	.12	.11	.11	.12
F.O.B. selling price	2.76	2.78	2.40	2.81	2.82	2.45
Freight[2]	.83	.86	.87	.50	.50	.50
Wholesale handling charges	.25	.25	.25	.25	.25	.25
Cost to retailer	3.84	3.89	3.52	3.56	3.57	3.20
Direct retailing costs:	.09	.09	.24	.07	.07	.13
Labor	.04	.11	.13	.01	.07	.09
Spoilage	.01	-	.07	-	-	.05
Materials	1.06	1.19	1.08	.98	1.13	1.15
Final gross margin[3]						
Retail value per carton	5.04	5.28	5.04	4.62	4.84	4.62
Retail value per pound	.12	.12	.12	.12	.12	.12

1 Based on observations of sales at two stores for four weeks in Chicago, and three stores for four weeks in Los Angeles, under controlled price conditions.

2 Shipped via refrigerated trucks having a flat charge of 50 cents per box into Los Angeles.

3 Final gross margin equals retail value or selling price less cost of product and direct retailing costs, which is the same as retailers original gross margin or mark-up less direct costs of retailing.

CHAPTER VIII

SUMMARY AND CONCLUSIONS BY CHAPTERS

Chapter II - History and Present Status

The prepackaging of some produce items has been going on for a number of years, but the prepackaging industry did not actually make much progress until the early 1940's. In 1944, the Columbus, Ohio Experiment conducted by the Ohio Agricultural Experiment Station in conjunction with the Atlantic and Pacific Tea Company gave the industry the needed impetus and brought it into prominence.

Then in 1946, the passage of the Research and Marketing Act provided a stimulus for research into consumer packaging. Through this Act, funds have been obtained for the needed economic and technical studies being conducted by some of the State Agricultural Experiment Stations and by the United States Department of Agriculture. These studies are leading the way in the prepackaging field; and more and more growers, repackers and retailers, realizing the potential benefits, are entering into this venture.

In spite of the fact that a considerable amount of experimentation has still to be done, the results have thus far been encouraging enough for prepackaging to progress. At each point in the distribution of fresh produce from the farm to the home, some notable achievements have been made.

Also, prepackaging companies in many markets are gradually developing their techniques, and nearly all fruits and vegetables are available

in consumer units. The equipment manufacturers, in turn, have constantly been designing new and improving existing apparatus in order to keep pace with the trend. Retailers, too, have followed through by installing more and more refrigerated display cases in their stores.

The factors which are important in determining the relative possibilities for prepackaging the various vegetables and fruits are: (1) need for utilizing loose items, (2) possibilities for reduction of waste and spoilage, (3) need for preparation or kitchen servicing by the prepackager, (4) relative costs of prepackaging and bulk packaging, and (5) the effect of prepackaging on preservation of quality.

There are other factors which are important, such as the availability of satisfactory machinery and equipment, unit value and the relative salability of prepackaged and bulk produce, but the points listed are basic in the determination of prepackaging prospects.

The place to prepackage is usually determined by the product itself. The hardier items are, in general, packaged at the shipping point; while the more perishable merchandise is being handled in the terminal markets so that the quality can be controlled more closely.

Chapter III - Why Prepackaging?

Modern customs and shopping habits and limited facilities for food storage found in the dwellings of today make prepackaging a natural development. It ties in perfectly with these trends by saving the housewife time, energy and space, besides simplifying her waste disposal problem.

The costly waste which characterizes present distribution methods is another reason for prepackaging. Prepackaging offers tremendous possi-

bilities for reducing this waste as well as increasing the consumption of fresh produce. Tare weights are greatly reduced because the heavy, bulky shipping containers and packaging ice are eliminated; trimmings and damaged produce can be left at the point of packaging to be used for various purposes. Also, prepackaging will bring about improvements in the marketing facilities because of the prepackager's desire to protect his brand name.

Prepackaging also extends the shelf life of fresh fruits and vegetables. In tests conducted by the Great Atlantic and Pacific Tea Company, it was shown that prepackaging and mechanical refrigeration retained the shelf life of seven vegetables studied within 95 percent of their original weight for periods of from six to 24 days - two to seven times longer than any other method tried.

Then too, it has been demonstrated that the reduction of waste, labor, handling and housekeeping costs along with the advantages of having fewer bottlenecks in the store and increased sales, usually increases store profits without increasing the cost to the consumer.

Consumers like prepackaging and have given several reasons for their liking. They can buy quality merchandise which is protected against bruising, moisture loss and discoloring by protective containers; and, in many cases, proper refrigeration is used in displaying this merchandise. Also, sanitation is preserved, faster shopping is made possible and there is a wider choice of vegetables at all times because there is no need for trimming to be done in the morning, or for ordering short so that a limited supply of produce is on hand in the evening.

Chapter IV - Problems

Not all of the merchandising problems have been solved; there are still many questions that remain unanswered. These problems fall into three categories - economic, technological, and biological; but all of them are very closely interrelated, each having a bearing on the other. However, they can be divided into seven general classes: (1) problems relating to containers, (2) labor costs, (3) consumer acceptance, (4) quality preservation, (5) marketing and transportation, (6) packaging equipment and (7) utilization of refuse.

As it has been indicated, many of these problems are gradually being solved through both research and experimentation. On the whole, though, the opportunities in this field are unlimited; and new avenues are open to growers and shippers, transportation agencies, packers and processors, as well as wholesalers and retailers.

Chapter V - Packages and Films

The prepackaging of produce goes hand-in-hand with the self-service methods of present day merchandising. However, there are problems involved that are not present when processed grocery items are sealed in packages. Produce is living and needs to breathe, it also requires more protection, and maximum care throughout the marketing process.

A very important part of the selling operation is the package - it has to do a good job. From a customer standpoint it should: (1) attract attention, (2) build confidence, (3) be convenient to handle and use, (4) look clean and sanitary, (5) look like a good value, (6) provide adequate visibility, (7) be a convenient size, and (8) meet legal requirements.

From the standpoint of the retailer, it should: (1) look like a fast seller, (2) deserve a preferred display, (3) be convenient to stack and display, (4) prevent spoiling during the selling period, (5) resist soiling, and (6) be easy to fill and close.

The basic containers for prepackaging can be divided into three types: (1) transparent film used as a direct wrap, (2) various types of bags, and (3) numerous shapes, sizes and types of cardboard forms used as containers ranging from flat cardboard to window boxes. Machinery can be adapted to any of these containers.

The transparent wrapping materials, which are also used in the construction of some of the bags and boxes, are usually made from cellophane, cellulose acetate, pliofilm or polyethylene. The film to be used depends on the place of packaging and the product. The nearer the packaging is done to the consumer point, the safer it will be; while the moisture and various gases given off by different varieties, as well as by the same varieties, differ with conditions. In general, however, leafy vegetables deteriorate largely because of wilting, which can be minimized by packaging them in moistureproof containers; sweet corn, peas and asparagus lose their quality as a result of rapid sugar losses, which can be controlled by speedy marketing and proper refrigeration. Root crops and potatoes suffer more from bruising and shriveling.

All the films are available in different thicknesses so they may be adapted to the merchandise. None of the film allows the produce to breathe sufficiently, though, and small holes should be made in the package or imperfect seals used. This has very little effect on shrinkage or wilting. When, and if, an all-purpose film is developed, it will have to

be moisture retentive, free from condensation under varying conditions of temperature and relative humidity, permeable to oxygen, easy to seal and convert and reasonable in price.

Chapter VI - Equipment, Layout and Technology

Equipment. There are many types of equipment used by the prepackaging industry, of which the most important are probably the semi-automatic and automatic wrapping and filling machines because they make possible the use of mass-production methods. The wrapping machines can be synchronized with many other attachments, which, when combined, can measure the length of the wrapping material to fit the package, perforate the material, label the packages, as well as set up the trays. Likewise, attachments are available for the bag-making machines, which allow the bags to be filled, closed, sealed, perforated and labeled. In addition, bag-making machinery is available which can manufacture various sizes of bags; this machinery also facilitates rapid changeovers.

There is also a lot of other equipment being used in the industry, such as the shredder, dicer, corer machinery, trimming tables, scales, extractors, shakers, suction apparatus, garbage disposal units, conveyors, coolers and ripening rooms, which are important and constantly being improved.

Plant layout. Proper planning and layout is one of the best ways of eliminating unnecessary expense, and wasted time and motion. Layouts fall into two categories - product or line and process or functional. When the line or product layout is used, the equipment is arranged in a straight line along the path that the produce is to travel; while in the process or

functional layout similar operations for all products are grouped together. For example, all the trimming is done at one place.

All operations should be tied in with one another so that there is no time lost in waiting. A good operation provides for adequate work stations during peak operations and gives maximum line balance at the same time. Motion and time study are the techniques used to analyze the work methods so as to attain the best arrangement.

Technology. The decomposition of fruits and vegetables is caused mostly by two factors: (1) harmful bacteria, and (2) chemical changes taking place in the plant. In order to bring about a favorable environment and reduce this decomposition, it is necessary that adequate provisions be made for: (1) proper care and handling, (2) sanitary environment and (3) adequate protection.

Refrigeration is the best known means of extending the shelf life of the produce. It controls the growth of the decay producing microorganisms and minimizes the heat units that are given off from the chemical changes taking place in the living perishables. The sooner the product is refrigerated after harvesting, the better. This is the reason why precooling before shipment is so important. The precooling, if possible, should be done before the produce is packaged in protective containers because they lengthen the time needed to bring about the desired temperature.

There are three methods of precooling used: (1) hydrocooling, (2) cold air and (3) vacuum. In hydrocooling, the produce is cooled by the use of refrigerated water, with the produce being either dunked in the water or run through a sprinkler system. Precooling by means of a cold

air blast before the lids are put on the lugs can be accomplished by cooling the air by the use of ice bunkers or mechanical refrigeration systems. The vacuum method of precooling is a more recent development. The produce is placed in a sealed chamber, and a vacuum is created by withdrawing air and water vapor from the chamber. The rapid vaporization of water from the produce caused by the vacuum lowers the temperature in a relatively short time.

Proper refrigeration in transit is the next important step. The temperatures brought about by precooling can be held reasonably well by the use of ice bunkers in refrigerated railway cars. Trucks are being equipped more and more with mechanical refrigeration units that will actually cool the load during transit and then hold the temperature as desired. Most of the refrigerated trucks, however, use ice bunkers with fans to keep the load cool after it has been precooled.

Another comparatively new method being used for preserving prepackaged produce when it is shipped in unrefrigerated trucks is that of the ice bag. Fifty-pound kraft paper bags which are coated with polyethlene on the inside, are filled with five pounds of hydro ice and heatsealed. Then the bag is placed in the master carton between the layers of produce.

Air cargo is a possibility for the future, but the rates will have to be lowered considerably. Nevertheless, packaged produce eliminates much of the weight and bulk inherent in the conventional produce containers, and offers much greater possibilities for this method of shipment.

The refrigeration facilities in the terminal markets are usually inadequate. However, as savings through the use of the right equipment are brought to the attention of more and more retailers, wholesalers and repackers, the conditions continue to improve.

Germicidal treatment of produce is used to control the decay-producing bacteria and other organic debris that help to spoil it. The germicide used must be non-toxic, odorless and free from corrosive action; it should also penetrate into the cavities, and produce fast action that will continue for a while after the produce is removed from the original solution.

Chlorine has been found to come the closest to meeting these requirements, but it should be modified with buffers and other agents to produce the most desirable effect. It has been demonstrated that the longer the storage period, the more noticeable the effects of this treatment. The composition of the solution and method of treatment should be adapted to each crop.

Plant sanitation is a special series of operations, quality control, equipment selection and maintenance and eternal vigilance, all based on a thorough knowledge of what to do, what to look for and what to do about it.

Chapter VII - Cost Studies

Four cost studies have been presented in this chapter so that a picture might be obtained of some of the costs involved in the prepackaging of produce. Also it is shown how these costs are offset by other economies, and how they compare with those inherent in bulk merchandise.

The Department of Agriculture and the American Stores Company. This study took place from 1945 in Kearny, New Jersey, to 1948. The prepackaging was done in the warehouse of the American Stores Company. Various items were prepackaged with the use of automatic wrapping and bagging machinery. Some of the results follow.

The cost of the packaging material, as was to be expected, varied with the type and size of the package and the kind of material used. Likewise, the cost of labor depended upon the type of produce being packaged, and the kind of package used because of the difference in the amount of work required in preparing each product.

The labor cost per package was very important in determining which items could be prepackaged economically, but it was not the only consideration. The relation of the cost of packaging to the retail price of the package and to the gross margin was of equal importance. Also the relation of the cost of packaging to the normal gross margin available when the commodity was handled in bulk and to the relative salability of the commodity when sold in bulk and prepackaged was very important. It was found that even when items such as string beans were relatively costly to prepackage, it might still be worthwhile to do so because the cost of handling them in bulk in the retail store might be even higher.

The quality of labor, rate of labor turnover and general wage level for unskilled labor also helped to determine the labor costs. Productivity should increase as skills are developed and as technological advances are made in machinery and equipment.

The additional costs of prepackaging were usually met through reductions of waste, spoilage and reduced labor costs in the retail store. The average spoilage rate on prepackaged refrigerated items was 2.5 percent, compared to 6.2 percent on the bulk-unrefrigerated items and 4.2 percent on the bulk refrigerated merchandise. The sales per man hour and the retail labor costs as a percentage of dollar sales were respectively higher and lower as more prepackaged items were handled in the stores.

The net profit in the prepackage stores was about the same as that in the bulk stores after the costs of waste, spoilage, unseen shrinkage and increased labor efficiency were taken into consideration. This was the case after packaging material, packaging labor, warehousing, refrigeration and supervision were charged to the prepackaged produce - everything but the depreciation costs.

The Purdue University Experiment. This study was made by the Department of Horticulture of the Purdue Agricultural Experiment Station in cooperation with the Minardo Brothers Fruit Company of Lafayette, Indiana. Here again, various fruits and vegetables were prepackaged.

The process of packaging included preparation, packaging and wrapping. Preparation involved washing, sorting, trimming, drying and waxing; packaging included weighing and placing the products in the cartons; the wrapping consisted of the placing of the wrap around the container by hand, with a semi-automatic wrapping machine doing the rest of the work - also some items were bagged by hand.

The labor used in the packaging operations was paid 60 cents per hour and accounted for 61 percent of the total packaging costs. It included washing, waxing, sorting, weighing and packaging. Of course, labor costs varied, depending on the item. For example, the cost was one cent for the lemons, and six cents for spinach.

The cost of materials included cartons, overwraps and cellophane bags, which accounted for 39 percent of the total packaging costs. This was practically a fixed cost, but it could be minimized by using the same size of container for several products.

The loss incurred in prepackaging the produce was determined partially by the condition and quality of the original product and by variations in net weight of the original products. Of course, the loss differed from product to product.

Prepackaging Cranberries Cooperatively. The cooperative Research and Service Division of the United States Department of Agriculture made this study, which sets forth some comparative cost figures for prepackaging and bulk packaging of cranberries. It is based on an analysis of the comparative packaging costs reported by a number of associations for the 1948 cranberry crop. Four cost factors were considered: unit containers, carrier cases, prepackaging labor and equipment depreciation.

It was found that it cost a few cents more to pack cranberries in a case of 24 one-pound bags than in a quarter-barrel box. However, the difference of 5.8 cents was nearly offset by the elimination of the quarter-barrel wooden box. The average costs for a case of 24 one-pound bags were as follows: cellophane bags, 31.5 cents; carrier case, 17.0 cents; packaging labor, 7.0 cents; equipment depreciation, 1.3 cents; for a total of 56.8 cents. The average costs for bulk packaging were: wooden box, 47.5 cents; packaging labor, 3.4 cents; equipment depreciation; 0.1 cents; for a total of 51.0 cents.

Cellophane bags were preferred over window cartons by the cooperatives mostly because they were much cheaper than the cartons. However, other reasons were given for this preference, too, such as; the looseness of the pack, the limited visibility and the fact that the film windows cracked and the glued edges sometimes did not hold up.

Prepackaging Apples at the Point of Production. This study was conducted by the Production and Marketing Administration of the United States Department of Agriculture in conjunction with the Washington State Apple Advertising Commission. Detailed studies were made to determine the cost of materials and direct labor when apples were prepackaged in different types and sizes of film bags and by different methods and in comparison with the standard box pack.

The labor and material costs for prepackaging apples in four-pound attached printed header bags were from 26 to 32 cents more per carton than the costs of packing them in the standard box; while the labor and material costs for three-pound printed header bags were 34 to 42 cents more than the bulk, depending on the method of packaging.

Material costs for prepackaged apples, including bags, cartons, and padding, ran from 60 to 74 cents for a carton of 11 four-pound bags, and 65 cents to $1.08 for a carton of 14 three-pound bags. The specific costs depend upon the type of bag used. Material costs for the standard pack were 44 cents for wooden box, lid, paper liner, and paper wraps. The labor costs on many of the bagging operations were below those of the standard pack, but the additional cost of the bags made it more expensive to prepackage apples than to bulk pack them in boxes.

Final gross margins (original retail mark-up less direct retail labor costs and spoilage losses) computed in carefully tabulated tests of all costs of retailing prepackaged and bulk apples showed that it was relatively more profitable to the retailer to retail prepackaged apples rather than bulk apples, because of greater sales, although the percentage gross margins

were approximately the same. Retail labor costs for the prepackaged apples were less than half as much as for the bulk product. Consumers used less than one-half as much time to select prepackaged apples as bulk apples, indicating that more customers could be handled per hour. Average spoilage and mark-down losses were heavier on bulk than on the prepacked fruit.

Conclusion

Granting the obstacles to be surmounted, prepackaging, nevertheless, holds considerable promise. The progress to date may not be revolutionary, but the direction in which the industry is moving is encouraging. Many of the problems are being ironed out gradually, partly through experience and partly through research findings of private and government agencies. Because much remains to be learned, this promises to be a challenging field for exploration in the years ahead. Opportunities ought to be abundant for the introduction of new and better containers, improved machinery and equipment designed especially for the needs of the prepackaging industry - opportunities limited only by human ingenuity and resources. New fields are opened to growers and shippers, to transportation agencies, to packers and processors, to wholesalers and retailers.

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