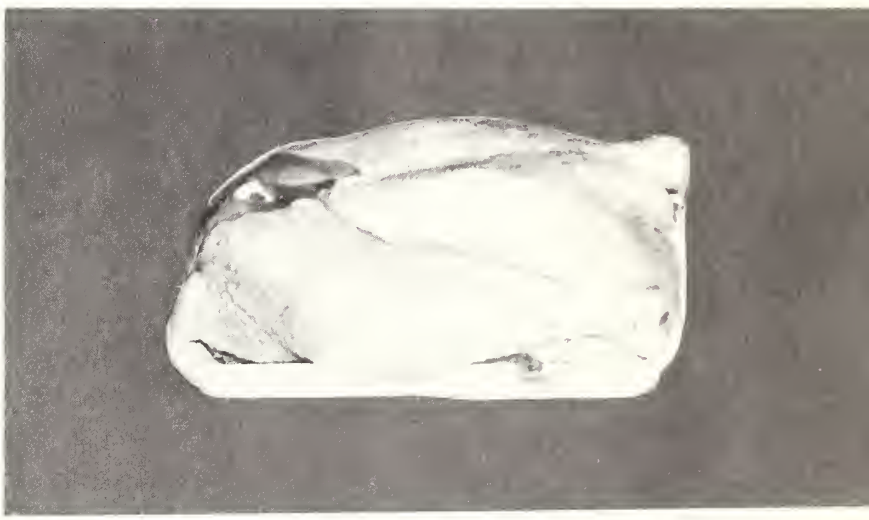
Marketing Research Report No. 662

Evaluation of Specified Shrink Films for Prepackaging FROZEN CUT-UP CHICKENS at Processing Plant



U. S. DEPARTMENT OF AGRICULTURE
Agricultural Marketing Service
Transportation and Facilities Research Division and Market Quality Research Division

PREFACE AND ACKNOWLEDGMENTS

This report is one of a number evaluating new packages and shipping containers and new methods of packing agricultural products in them. Most of these reports were concerned with packaging fresh fruits and vegetables. The study on which this report is based is part of a broad program of research aimed at improving marketing efficiency and expanding markets for farm products.

Prepackaging frozen cut-up chickens at processing plant level promises to be a means of supplying better quality chickens to consumers at lower marketing costs, although the methods of prepackaging cut-up chickens with various shrink films at processing plants are still in the early stages of development. This report was written in response to many inquires received by the Department.

The authors are grateful to Cagle's Inc., Atlanta, Ga., for processing plant facilities, equipment, and chickens for packaging with experimental films; and to the Cryovac Division of W. R. Grace Company, Cambridge, Mass.; E. I. DuPont DeNemours & Company, Wilmington, Del.; Reynolds Metals Company, Richmond, Va.; The Goodyear Tire and Rubber Company, Akron, Ohio; and the Union Carbide Company, New York, N. Y., for supplying film wraps.

CONTENTS

Washington, D. C. July 1964

SUMMARY

Five types of clear shrinkable films were evaluated as wraps for cut-up chickens prepackaged and frozen in a Georgia processing plant. In normal commercial marketing, the prepackaged frozen birds were trucked to a Philadelphia warehouse and later put on sale in Wilmington, Del., food stores.

The films evaluated were: (1) ½-mil cast polyvinyl chloride; (2) 1-mil extruded polyvinyl chloride; (3) 1-mil irradiated polyethylene; (4) 1-mil polyethylene; and (5) 1-mil polypropylene.

Upon arrival of the packages at the retail stores, the ½-mil film showed substantially more tearing than the 1-mil films; among the four 1-mil films, differences in the incidence of tearing were not significant. All five films held up well while on display.

The meat managers liked the poultry prepackaged at processing plant because it permitted them to employ available store labor more advantageously for other jobs. They also welcomed the longer shelf-life of the frozen chickens as compared with fresh poultry.

Although this was the first time that frozen cut-up chickens had been sold on a commercial scale in Wilmington, the shoppers bought more than had been expected, and as time went on, sales increased relative to sales of fresh chickens. The shoppers appeared to find no differences among the five test films, purchasing one about as readily as another.

No significant difference in bacterial counts on the breast or in the drip could be attributed to differences in type of overwrap. Shelf-life of chicken in all five wraps, when placed in a 34°F. cooler in a frozen condition, was about 26 days. Drip increased with length of storage, but no difference in amount of drip resulted from differences in overwraps.

EVALUATION OF SPECIFIED SHRINK FILMS FOR PREPACKAGING FROZEN CUT-UP CHICKENS AT PROCESSING PLANT

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INTRODUCTION

A recent survey has indicated that 60 percent of housewives place fresh chickens in their freezers on the day of purchase. 2/ Consumers, therefore, will probably accept fryers prepackaged and frozen to benefit from the superior packaging and freezing facilities of commercial processing plants. With the acceptance of frozen cut-up poultry, economic and practical problems arise in packaging a new type of product.

In April 1961, researchers of the U.S. Department of Agriculture participated in the Southeastern Poultry and Egg Association Processors Packaging Workshop at the University of Georgia, Athens, Ga. At this meeting, researchers pointed out the obvious economies of prepackaging products on a mechanized assembly line with all the advantages of automatic packaging machinery and equipment and labor-saving handling methods. It also was pointed out that there are so many tangential factors or ramifications affecting the decision of where the prepackaging of fresh poultry should be done that a change is likely to proceed at a rather slow and steady pace over a period of several years. Others at this meeting contended that the prepackaging of frozen cut-up poultry at processing plant level would develop quite rapidly. But in mid-1962 only 16 percent of all chickens were cut up and packaged in the processing plants under Federal inspection. Much of this cut-up chicken is packaged in consumer-size cartons and a very small percentage in trays overwrapped in shrinkable film.

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Mr. Kotula, research food technologist, and Dr. Mercuri, research bacteriologist, are in the Field Crops and Animal Products Branch, Market Quality Research Division, AMS.

2/ Smith, H.D. 60 Percent of Housewives Put Chicken in Freezer. Poultry Processing and Marketing, February 1962 (p. 40, 106).

In a preliminary survey of a number of poultry plants in the Southeastern States, a packaging specialist with the Transportation and Facilities Research Division found that poultry processors showed considerable interest in prepackaging frozen cut-up poultry, but only two plants were doing it on a large scale. In that survey, industry spokesmen indicated that the processors were not satisfied with the packaging materials available at that time. They hoped new packaging materials, machinery, and equipment would become available to help reduce the cost of extensive hand labor required in packaging frozen cut-up chickens.

Irradiated biaxially oriented polyethylene film was one of the first films found to be satisfactory for prepackaging cut-up frozen chickens. It was the only shrinkable film available with excellent clarity and shrink properties which could withstand the very low temperatures (minus 40 degrees) in the blast freezer.

The objective of this study was to test the physical performance of other shrink films for prepackaging frozen cut-up chickens and trade and consumer reaction. Further studies are needed to determine the comparative all-round advantages of the films tested in this study, taking into consideration their cost, performance, machineability, and general suitability for frozen cut-up chickens.

MARKET TEST

Procedure

The five shrinkable films selected for testing are listed below, along with the sealing and shrinking temperatures used on the packages:

Film 3/	Sealing temperature	Shrinking temperature
	°F	°F
1-mil irradiated polyethylene (Cryovac L, W. R. Grace Co.)	325	300
1-mil polypropylene (Udel, Union Carbide)	325	425
1-mil extruded polyvinyl chloride (ST Vitafilm, Goodyear)	275	350
½-mil cast polyvinyl chloride (Reynolon, Reynolds Metals Co.)	275	270
1-mil SH polyethylene (DuPont)	275	340

Representatives of the film suppliers provided the technical assistance necessary to assure the proper sealing and shrinking temperatures.

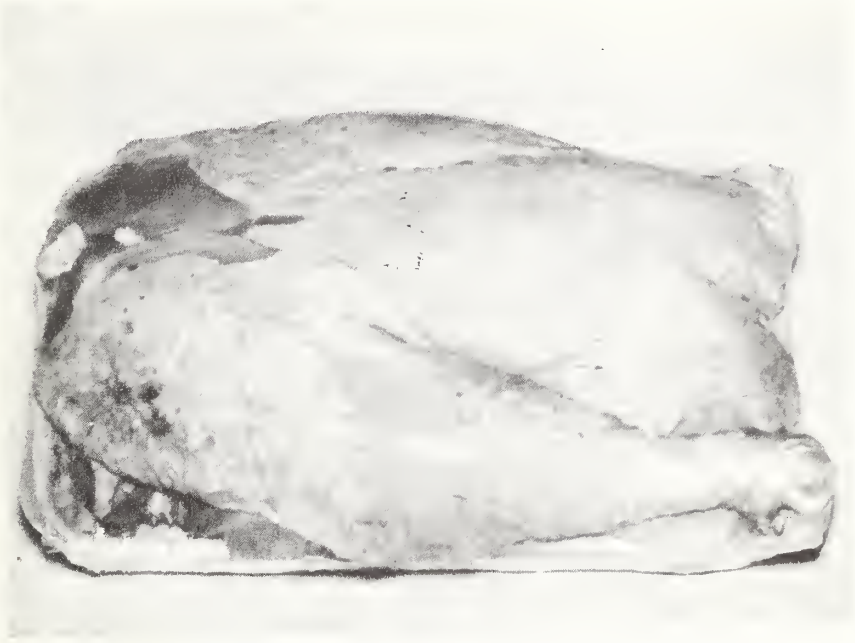
3/ Use of trade names is for identification purposes only and does not constitute endorsement by the U. S. Department of Agriculture.

The packages wrapped in five different types of film contained approximately the same average net weight of chickens, varying from 2.5 to 2.7 pounds. Each package and each master container was coded with colored tape for later identification.

In a Georgia processing plant on April 17, 1962, the chickens were cut up, wrapped, placed on large racks, and wheeled into a blast freezer at approximately -40°F. The following day the frozen cut-up packaged chickens were removed from the freezer and packed into 50 fiberboard master shipping containers. Each of the five types of film packages was packed 24 to a box in 10 boxes. The packages were examined closely. All with tears, holes, or openings in the film were eliminated.

The packaged chickens were shipped to Philadelphia and held in cold storage at -10°F. until June 7, when equal numbers of each type of package were distributed to three retail supermarkets in Wilmington, Del. They were displayed in open top refrigerated meat display cases beside displays of chilled chickens which had been cut up and packaged in the stores. Both the chilled and frozen chickens were priced the same. Approximately equal numbers of the different types of packages were placed on display. Additional quantities of the packaged chickens were distributed to the same three stores during the subsequent 2 weeks.

Figures 1 to 7 show how the chickens were wrapped, sealed, frozen, and displayed.



BN-20878

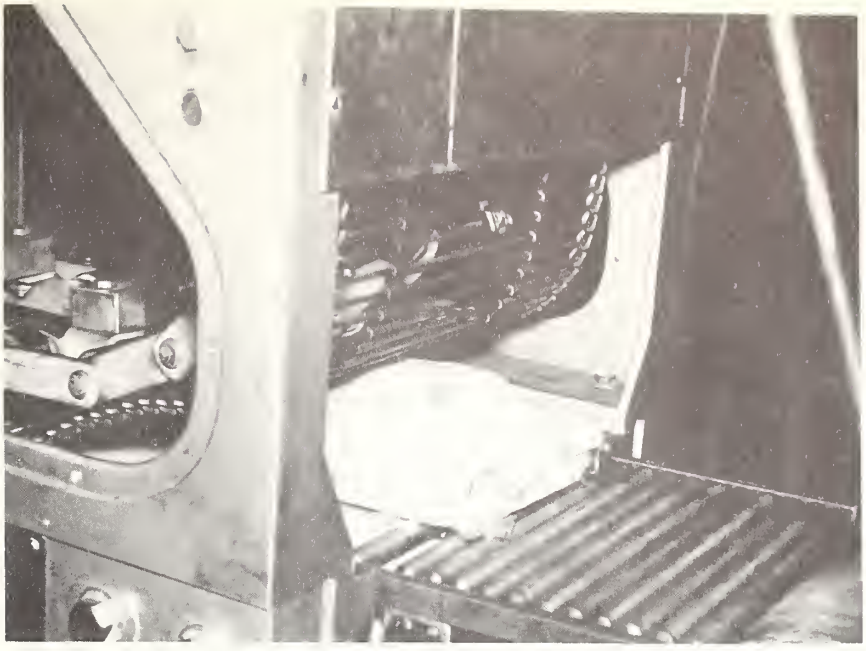
Figure 1.--This cut-up chicken was wrapped in transparent polyethylene. However, so excellent was the transparency of all the films tested, store patrons could not distinguish one from another.

BN-20880

Figure 2.--Whole eviscerated chickens were taken from these moving hooks, cut into parts, and placed on pulpboard trays.

BN-20881

Figure 3.--Trays of cut-up chickens were manually overwrapped with clear plastic film pulled from roll in dispenser at right.



BN-20879

Figure 4.--This piece of equipment compacted the chicken parts and at the same time sealed the ends of the film which had been folded under the bottom of the trays.

BN-20882

Figure 5.--Prepackaged chicken parts are shown on rack just before being moved into freezer.

BN-20883

Figure 6.--Each pallet load of 10 boxes contains 240 packages of cut-up chickens. The different types of film wraps are code identified by crosses of different colors on box ends.

BN-20884

Figure 7.--Film-wrapped trays of frozen cut-up chicken are displayed in supermarket.

Breakage of Film Wraps

In Processing Plant

Upon removal from the freezer in this Georgia processing plant, the number of packages with holes or tears in film was as follows: Irradiated polyethylene, 3; polypropylene, 4; cast polyvinyl chloride, 17; extruded polyvinyl chloride, 6; and SH polyethylene, 6.

In Transit and Storage

After delivery to the Wilmington stores, the packages of frozen chicken parts were examined as they were removed from the master containers. The percentage of overwrapped trays with tears in the film is shown in table 1.

Table 1.--Percentage of trays of frozen cut-up poultry arriving with torn film overwraps at 3 Wilmington supermarkets, by type of film, summer 1962 1/

Store	1-mil irradiated polyethylene	1-mil polyethylene	1-mil polypropylene	½-mil cast polyvinyl chloride	1-mil extruded polyvinyl chloride
	Percent	Percent	Percent	Percent	Percent
A	12.5	6.9	9.7	20.8	11.1
B	2/	0	4.2	22.2	4.2
C	18.0	10.4	9.7	43.8	16.7
Average 3 stores	13.8	6.2	7.1	30.4	9.5

1/ Average of four shipments in store A and three shipments in stores B and C.

2/ In one shipment the film on 71 percent of the packages was torn. The master container in which they were delivered was crushed and broken, apparently the result of abnormally rough treatment.

The ½-mil cast polyvinyl chloride film had substantially more tears than the other films in the test. The manufacturer of this film, when informed of the results, immediately recommended the use of 3/4-mil film in lieu of ½-mil film for prepackaging frozen cut-up chickens. The difference in the amount of breakage among the other films was not statistically significant. Most of the tearing occurred along the sides of the packages, probably as a result of friction against the master containers when they were handled or in transit. Researchers in the store to observe handling and sales of the frozen cut-up chickens reported practically no tearing of the film which could be attributed to consumer handling of the packages in display cases. Although the five films differ considerably in clarity, lustre, and transparency, these differences were not noticeable while the packages were on display.

All five types of plastic films fitted the contour of the birds nicely. A little film relaxation was noticed on the thawed birds. Irradiated polyethylene film appeared to cling to the thawed birds a little better than the other four films.

The ½-mil cast polyvinyl chloride film wrinkled slightly more than the other films. In a few cases the SH polyethylene film and the polypropylene film showed faint traces of cloudiness.

Sales of Film-Wrapped Frozen Chickens

Frozen birds overwrapped in the different types of film were displayed both side by side in rows and randomly distributed in poultry cases. The rows were rotated to eliminate location effect in the display cases. Displays were periodically replenished to insure that equal numbers of birds in the different types of film would be available for selection by the consumer at all times.

The birds were displayed in cases ranging from 26° F. bottom to 35° F. at a height of three birds. Frozen poultry in the third or top layer partially thawed in about 8 hours, while that in the bottom layer remained frozen over 3 days. Researchers recorded all sales in two of the three test stores. Total sales per week by each type of test film are shown in table 2.

Table 2.--Weekly sales of shrink-wrapped frozen cut-up poultry in 2 Wilmington supermarkets, by type of film, summer 1962

Week & store	1-mil irradiated polyethylene	1-mil polyethylene	1-mil polypropylene	½-mil cast polyvinyl chloride	1-mil extruded polyvinyl chloride
	Birds	Birds	Birds	Birds	Birds
1st week:1/					
A.....	16	20	18	21	22
2nd week:					
A.....	17	16	13	12	20
B.....	22	16	18	13	19
3d week:					
A 2/....	11	11	11	10	11
B.....	21	20	19	16	20
4th week: 3/:					
A.....	--	19	16	21	22
B.....	--	22	18	20	22

1/ Only one supermarket received test poultry the 1st week of experiment.

2/ Market Quality Research Division purchased 65 birds from supermarket A, 13 from each of 5 boxes of 24, for evaluation of quality. The 11 chickens remaining in each of 4 boxes were sold before the end of the week; one bird from the fifth box was not sold.

3/ No irradiated polyethylene film packages were available to put on sale during the 4th week.

Analysis of daily sales data for the first 3 weeks of the experiment showed that differences in sales between birds overwrapped in the respective test films were not significant.

Comparative Sales of Frozen and Fresh Cut-up Chickens

The frozen chickens in test packages were overwrapped at the processing plant in clear shrinkable films without printing. At the store, meat wrapping clerks affixed small paper labels with weight and price. The chickens were not specifically identified as frozen.

Fresh ice-chilled chickens were cut up, trayed, weighed, and wrapped in cellophane in the backroom of the stores. The film bore colorfully printed name brands but the chickens were not specifically identified as fresh.

The acceptance of frozen poultry in this test was better than had been anticipated. The temperature of the display case averaged 34°F. so the frozen chickens partially thawed while on display. Sales of frozen as compared with ice-chilled poultry increased as time progressed in test stores as shown in table 3.

Table 3.--Number and percentage of frozen and ice-chilled chickens sold in 2 Wilmington supermarkets, 1962

Week and store	Total birds	Ice-chilled birds		Frozen birds	
	Number	Number	Percent of total	Number	Percent of total
1st week:					
A	377	280	74	97	26
2nd week:					
A	225	147	65	78	35
B	283	195	69	88	31
3d week:					
A	171	117	68	54	32
B	272	176	65	96	35
4th week:					
A	159	81	51	78	49
B	219	137	63	82	37

Sixty-five prepackaged frozen cut-up chickens, 13 wrapped in each of the five test films, were picked up upon arrival in a Wilmington retail store, taken to a USDA laboratory in Beltsville, Md., and stored in a refrigerator at 34°F., a typical temperature recorded in the display cases in the retail stores where the chickens were being test marketed. Temperatures in three test supermarkets were 24° to 26°F. in the lower layer of the display cases, 25° to 34° in the center layer, and 26° to 34° in the upper layer.

Procedure

One bird from each of the five overwrap groups was removed after thawing for 48 hours in the 34°F. walk-in cooler. Odor was evaluated subjectively by two investigators as soon as the package was opened.

Samples for bacteriological examination were obtained from the breast skin of each bird by swabbing, with the aid of a template, an area of 12.3 sq. cm. for 30 seconds, using a cotton swab moistened with 0.1 percent peptone. The swab was broken in half and the cotton-tipped portion was placed in a milk dilution bottle containing 99 ml. of diluent (0.1 percent peptone). Serial dilutions were plated on tryptone glucose extract agar and incubated at 32°C. for 48 hours.

Fluorescent colonies were determined by visual examination of all surfaces of the poultry parts under ultraviolet light.

The percentage drip was determined for each package by the formula:

$$\frac{\text{Weight of drip} \times 100}{\text{Weight of bird, drip, and tray} - \text{Weight of tray}}$$

The above sampling techniques were carried out after the birds had been stored 2, 5, 6, 7, 8, 9, 12, 14, 16, 19, 21, 26, and 30 days at 34°F. Sampling days were selected in a way that would insure terminal poultry shelf life prior to sample depletion.

Findings

Shelf life of the prepackaged frozen cut-up chickens was about 26 days, when the bacterial count on the skin of the birds reached 10 to 100 million per square centimeter. Off-odors, which usually develop at this level of contamination, 4/ were detected. Analysis of variance of the logarithms of the bacterial counts (table 4) indicated no significant difference among the five film wraps studied.

4/ Ayres, John C., Ogilvy, W. S., and Stewart, G. F. Post Mortem Changes in Stored Meats. 1. Microorganisms Associated with Development of slime on Eviscerated Cut-Up Poultry. Food Tech., 1950, 4: 199-205.

Other studies in the same laboratory indicated that similarly packaged fresh (non-frozen) chickens also held at 34°F. had an average shelf life of about 13 days.

Table 4.--Total bacterial counts on breast skin surface of frozen broiler chickens packaged in 5 types of overwrap and stored at 34°F. 1/

(Million per square centimeter)

Day of storage	1-mil irradiated polyethylene	1-mil polyethylene	1-mil polypropylene	½-mil cast polyvinyl chloride	1-mil extruded polyvinyl chloride
2	0.014	0.051	0.004	0.001	0.004
5	.013	.024	.001	.003	.003
6	.019	.040	.025	.013	.021
7	.005	.016	.003	.006	.004
8	.046	.017	.016	.024	.040
9	.018	.200	.035	.025	.046
12	.019	.011	280.000	.003	.018
14	.025	.014	.022	.028	2,400.000
16	.170	.017	.820	.022	.013
19	2.200	.120	.100	.820	.041
21	2.500	.030	.017	5.500	1.500
26	23.000	2.700	2,800.000	1.600	2.400
30	180.000	8.100	230.000	30.000	22.000

1/ Placed in cooler in frozen condition.

Fluorescent colonies of bacteria were found in each of the five types of test packages after the 21st day. The occurrence of these colonies, however, was neither consistent nor related to the type of package.

The drip in the trays, expressed as a percentage of the frozen bird weight, increased with storage time. Differences among the package types were not significant.

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