INFLUENCE OF PACKAGING MATERIAL AND FREEZING TEMPERATURES ON CONSUMER PREFERENCE FOR TURKEY PIECES

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INFLUENCE OF PACKAGING MATERIAL AND FREEZING TEMPERATURES ON CONSUMER PREFERENCE FOR TURKEY PIECES

By

Joseph Herman MacNeil

An Abstract

Submitted to the College of Agriculture, Michigan State University of Agriculture and Applied Science in Partial Fulfillment of the Requirements for the Degree of

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The practice of merchandising ready-to-cook turkeys instead of the traditional dressed bird has become a standard procedure. Associated with this trend have been changes in methods of freezing and type of protective overwrap in which turkeys are merchandised.

Although much has been accomplished in the improvement of processing techniques, there are still a number of problems that have to be solved.

Immersion freezing of poultry is becoming more popular. This process not only increases rate of freezing but also results in a light colored appearance in the product.

The primary use of a protective overwrap is to maintain the initial quality and appearance of the product, however many processors and retailers have gone beyond this to use the package as a powerful selling tool.

Materials used in this study were (1) heat shrinkable cryovac sheets (2) MSAT cellophane sheets (3) polyethylene sheets (4) saran sheets.

Products packaged in each one of the above materials were presented to a Consumer Preference Panel in Detroit. Panel meetings were held in November and December, 1957, and February and April, 1958. Polyethylene packaged products were preferred by more panel members than any of the other packaged products.

Significant differences were found in the preferences of the panel members between afternoon and evening as well as among different panels.

Turkey quarters and pieces were frozen at 0°F, -20°F, -40°F, and in a salt brine solution at -43°F prior to storage at 0°F. After storage periods of 1, 2, 4, and 6 months, products were presented to the Consumer Preference Panel in Detroit.

Turkey quarters partially frozen in a brine solution and stored for a period of one and two months were preferred by a majority of the panel members. After a storage period of four months, the number of members selecting brine frozen quarters as their number one choice had declined considerably. After six months of storage, only five of the afternoon panel members (9%) selected brine frozen quarters as their first choice and in the evening only 7 members (3%) preferred brine frozen quarters.

Preference for turkey pieces frozen in brine did not follow the same pattern as turkey quarters, being preferred by the least number of members in each panel with the exception of the first Panel.

After storage of four and six months, the majority of panel members preferred the products frozen at -40°F.

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INTRODUCTION

Consumer preferences have usually been determined by actual purchase of a particular product under normal retail situations. Opportunity for adequate selection by the consumer has usually not been possible because of the limited number of items displayed. This has been particularly true in most retail stores.

The practice of merchandising ready-to-cook turkeys instead of the traditional dressed bird[1] has recently become a standard procedure. Associated with this trend has been changes in methods of freezing, type of protective overwrap and form in which turkeys are merchandised.

Since most turkeys are raised in the summer and ready for market in the fall it is necessary to store them in the frozen state for varying lengths of time before they are merchandised. A protective overwrap is thus required to maintain the initial quality and appearance of the product. At present, many processors and retailers are utilizing the package not only to protect the product but also as a powerful selling tool.

The practice of using liquid coolants to quick freeze poultry

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[1] Ready-to-cook poultry means any dressed poultry from which the protruding pinfeathers, vestigial feathers, head, shanks, trachea, esophogus, entrails, kidneys, reproductive organs and lungs have been removed. Dressed poultry means poultry which has been slaughtered for human food with head, feet, and viscera intact and from which the blood and feathers have been removed.

is becoming more popular. This process not only increases rate of freezing but it also results in a light colored appearance of the product.

One of the objectives in this study was the evaluation of consumer preference for a number of different turkey pieces which had been frozen at different temperatures, including brine frozen products.

Few studies have been conducted to determine the consumer preference for various types of packaging materials although the protective values have received more consideration. With these factors in mind another part of this study was designed to gain additional information on consumer preferences for various packaging materials.

REVIEW OF LITERATURE

Packaging Materials

History

The development of packaging materials has expanded tremendously since World War II. Woodroof, Atkinson, and Shelor (1947) reported that until 1936 there were no wrapping materials on the market especially made for frozen foods such as meats, fish, and chicken. The use of special packaging materials for fresh products has also gone through a period of prolonged inactivity until recently. During the past fifty years marketing problems have changed being influenced by growth and geographical distribution of population, and by technological changes in production, processing and merchandising.

The introduction of self-service counters in large supermarkets has resulted in a need for better packaging materials. Carpenter, Kendall and Gunn (1955) discussed self-service and its effect on poultry sales. They concluded that self-service would increase volume of sales which in turn results in lower costs.

Shockley (1955) reported that in addition to proper protective qualities, a package should be of proper size, style, and construction. With the introduction of mechanical packaging machines, the size

and weight of the product became a limiting factor. Those materials which could be adapted to machine application were given closer study and materials which could be heat sealed tended to have some advantages, other properties being equal. The standardized weight package and packaging at the processor level would be more efficient in that special equipment and trained labor could be used to perform the tasks involved (Ramsay, 1954).

The use of transparent films for packaging poultry has been increasing, but the preference for these films has not been substantiated by basic research. A number of the packages on the market today have been developed by chance rather than by market research (Anonymous 1956), which again points out the lack of pertinent information on packaging. Ferguson (1955) stated that a consumer survey on packages showed a preference for meat packages with a transparent top well labeled with weight and price.

Protective Performance

Winter (1947) reported, that other factors being equal, the better the wrapping material the longer frozen meat, poultry, and fish will retain their original flavor and color during storage at 0°F. He based his conclusions regarding packaging materials on the theory that the best packaging materials appear to be those which are most effective in excluding oxygen. This, in addition, should result in better patron satisfaction.

Woodroof, Atkinson, and Shelor (1947) found that aluminum foil adequately protected frozen poultry from desiccation and loss of aroma and flavor for at least one year. By using cellophane as a wrapper the desirability was lowered approximately twenty-five percent. Margolf et al (1956) in their study of type of scald and wrap on market quality of frozen poultry showed that weight losses were greatest for carcasses wrapped with cellophane, less for those wrapped with pliofilm, and least for those wrapped with polyethylene. They also found that full scalding was a satisfactory practice when stored carcasses were wrapped with polyethylene or pliofilm. Kish (1953) showed that the over-all protective performance was similar for cellophane, polyethylene, saran, and pliofilm, throughout a forty-eight hour packaged period. Although careass color changes of meat were slightly greater in cellophane packages after seventy-two hours, the presence of off odors and slime development was not as great as with meats packaged in the other test films. Cellophane was superior to all films tested in minimizing moisture condensation, in package appearance and brilliance and in ease of handling during packaging operation. Klose and Lineweaver (1951) stated that microbial growth is one of the most serious problems in the deterioration of chilled packaged poultry, however controlling dehydration and color changes and using a tight

fitting packaging film are also very important from the standpoint of consumer acceptance and satisfaction.

Consumer Acceptance

Very little has been reported on consumer preferences for a large number of packaging materials that are on the market at the present time. This is a relatively new field and there are new materials being developed continuously while existing ones are being improved. Fryers packaged with unprinted polyethylene, printed polyethylene, unprinted cellophane, printed cellophane, and a box type with a cellophane window were presented to a Detroit consumer preference panel (MacNeil, Larzelere and Dawson, 1958). Plain samples of each material were ranked above the corresponding print sample, indicating a consumer preference for the plain transparent material.

Jasper (1955) reported on actual purchases by consumers of fresh fryers that were offered in a retail market. Some of these fryers were unpackaged while others were packaged with unprinted cellophane, unprinted polyethylene and unprinted cryovac. In two separate tests conducted more cellophane packaged products were purchased than were products packaged in any of the other materials. Polyethylene packaged products were the second choice in the two tests.

The importance of the package and its acceptance or rejection by retailers was emphasized since 47 percent of the retail organizations interviewed either refused to sell or threatened to stop selling products solely because of poor packaging (Anonymous 1957). This also points out that there is a great deal yet to be done in the field of packaging. Finding out what type of package is preferred by the consumer is one of the major questions which must be satisfactorily answered.

Freezing

Artificial refrigeration was first used to freeze food commercially in the United States about 1865 (Tressler and Evers, 1947). At that time meats and fish were frozen in crude rooms insulated with sawdust and cooled by ice and salt mixtures.

Birdseye (1946) reported his theories on the changes which take place during the freezing operation. He states that both plant and animal tissues are composed of a multitude of individual cells, in and around which is a complex liquid containing numberous minerals, salts, vitamins, proteins and other substances. As the temperature of this liquid is brought below 32°F. there are a number of physical and chemical changes which take place in it. One of the most important changes is the formation of ice crystals.

The size of the crystals formed, in the temperature range of 32°F. to 25°F., is determined to a large extent by the speed with which the product goes from 32°F. to 25°F. The faster the rate of freeze the smaller the ice crystals and the slower the rate of freeze the larger the ice crystals. The temperature range mentioned above is referred to by Pennington (1941) as the "zone of maximum crystalization". Koonz and Ramsbottom (1939) found that rate of freezing affects the size, number, and location of ice formations. Nearly instantaneous freezing produced minute, evenly distributed ice columns within the fibers. With a somewhat slower rate of freezing the ice columns within the fibers were larger in diameter and fewer in number. The importance of the size of the ice crystals was emphasized by Birdseye (1946) in his discussion on the theory of freezing. He stated that large ice crystals, as a result of slow freezing, could result in physical damage to the cell (cell rupture), or a physiochemical change which he termed salt dehydration. Sair and Cook (1938) in studies with fish and beef, found that when these two products had been frozen slowly in air, they exude a certain amount of fluid or drip when thawing, indicating physical damage to the cell and consequent loss of liquids.

DuBois, Tressler and Fenton (1942) reported that it was difficult to note by casual examination the difference between chickens frozen rapidly and those frozen more slowly. However they could be

differentiated by a microscopic appearance of cross sections of the muscle tissue.

Willis, Lowe and Stewart (1948) showed that birds frozen at 10°F. showed a considerable amount of desiccation and darkening while birds frozen at -10°F. were in much better condition but even at this temperature they did begin to darken after nine months of storage.

The consumer selects poultry on the basis of appearance so the factor of color may be a very important factor for industry consideration. Apparently, although much research had been done on freezing procedures, poultry is still subjected to freezing in a haphazard fashion. Baker (1953) reported that almost half of the frozen turkeys in New York State became discolored during the freezing operation. The effect of freezing rate on color of meat was discussed by Ramsbottom et al (1949). They reported that steaks frozen by contact with dry ice (-110°F.) were much lighter than steaks frozen at 20°F., while steaks frozen at -20°F. were intermediate between the two latter temperatures and approached the fresh steaks in color. Baker (1953) used freezing temperatures for turkeys of -20°F., 0°F. and 5°F., reported results similar to those obtained by Ramsbottom with meat. Baker's results showed that the turkeys frozen at -20°F. were the most pleasing while those frozen at 5°F. were very dark in color. After thawing all birds the original color was restored. By refreezing the

birds in a reversed order, that is, the birds originally frozen at 5°F. were frozen at -20°F., similar results were obtained, the birds frozen at -20°F. being the most pleasing in color.

Similar results on color were obtained by Esselen et al (1955). A further point brought out by this study was that subscalded poultry (138-140°F.) was particularly susceptible to discoloration when frozen.

Baker (1955) in repeating his tests on the effect of rate of freezing on poultry reported that the discoloration involved in slow freezing took place in the flesh rather than the skin. The procedure used in his study was to skin the birds and freeze skinless birds and skin separately at two temperatures, -20°F. in air blast and 20°F. in still air. At -20°F. the flesh and skin were both white while at 20°F. the flesh was dark while the skin was light. Studies conducted by Klose and Pool (1956) were in general agreement with Baker on the need and importance for fast freezing, however they differed in respect to processes involved in the color change. Klose and Pool stated that appreciable and easily detectable optical changes take place in the skin in addition to those in the flesh surface layer.

While temperature is the main factor in rates of freezing and color of resulting product, Baker (1953) and Lentz and van den Berg (1957) pointed out the importance of the movement of the surrounding

atmosphere. van den Berg and Lentz (1958) showed that lightness and uniformity of appearance in air blast increased markedly when air velocity at -20°F. was increased from 0 to 700 ft. per minute. Baker (1953) suggested that a warm layer of air surrounds the bird in still air and acts as insulation.

Cook (1939) reported that humidity also affected the surface drying of frozen poultry; he recommended a humidity of about 98% or higher to minimize freezer burn for a one year holding period at 13°C.

The principles of freezing by direct immersion and spraying with a liquid have been known for some time. A brine spray freezing process was used in the poultry industry several years ago. However the use of direct contact liquid in its present form is new.

There are indications that the consumer has a preference for a light colored turkey, capon or chicken (Pflug, 1957) and consequently poultry processors are becoming more interested in immersion freezing. Freezing methods giving a lighter colored bird have increased in importance with the trend toward higher scald temperatures. The immersion method, besides giving a light colored product, makes use of the fact that the higher coefficient of heat transfer obtained in liquid as compared to air makes more efficient use of refrigeration capacity.

Sodium and calcium chloride brines and propylene glycol solutions are at present being used as the liquid coolants. The heat transfer characteristics of sodium chloride brines are slightly higher than those for propylene glycol solutions. Sodium chloride is also more economical in first cost. The low initial cost of sodium chloride may be off-set by its corrosive effects.

Lentz et al (1957) reported on the factors affecting appearance of frozen birds. It was their observation that the most important factors affecting the appearance of the frozen bird were its initial appearance and temperature, and the temperature of the coolant. The color of the skin itself did not change during freezing at any temperature, but its opacity did depend on freezing conditions, and gave white skinned birds a white, uniform chalky appearance. Yellow-skinned birds had the same characteristics of opacity and uniformity but the color depended on the amount of yellow pigment in the skin. The work of Clayton (1957) and Pflug (1957) showed similar results in using immersion freezing.

Lentz and van den Berg (1957) recommended a minimum immersion time of twenty minutes at -20°F. to insure retention of optimum appearance after storage. This time and temperature holds true for both chickens and turkeys however the time should be increased to forty minutes for turkeys for optimum results. Esselen et al (1954) in his

studies gave a time range for immersion of from 20 to 30 minutes per pound for a complete freeze. For a quick dip in -20°F. brine, followed by holding in cold storage, they recommended times in brine of 6, 35, and 45 minutes for broilers, twelve pound turkeys and twenty-two to twenty-seven pounds ready to cook turkeys.

Davis (1954) reported that immersion freezing is twelve times faster than some of the methods used in freezing poultry with cold air after chilling in slush ice, however he recommended that the immersion process at present be used only for ready-to-cook poultry packaged in moisture proof and vapor proof bags prior to chilling or freezing.

Brine cooling of birds has also been reported by several workers including Sweet and Stewart (1942),Connolly et al (1954), Esselen et al (1954), and Davis (1954). The use of brine for cooling is referred to as the "cold shock" method by Sweet and Stewart (1942). The procedure reported by these workers was to immerse or spray birds with a salt brine (20°-32°F.) from ten to sixty minutes and then store them at 32°-35°F. and allow them to cool to an internal temperature of 34°-36°F. The theory of using stored up refrigeration in the birds for cooling purposes is employed here.

Very little is known concerning the interaction of packaging and immersion on freezing since both are relatively new fields.

PROCEDURE

A. Freezing Procedure

Twenty-four Bread Breasted Bronze tom turkeys were selected for uniformity of size and quality. The turkeys were slaughtered using an electric shock for immobilization, bled by an outside cut, scalded at 142°F. for one minute and fifteen seconds, picked by machine, placed in a slush ice tank and allowed to cool for four hours. After this period of cooling the turkeys were eviscerated and replaced in a slush ice tank and held for further cooling.

After overnight cooling, eight turkeys were cut into quarters, using a commercial meat band saw, immediately tray packaged using heat shrinkable cryovac sheets as an overwrap and held at 35°F. until the entire processing operation was completed. The remaining sixteen turkeys were cut up into breasts, thighs and drumsticks and packaged as described above.

All birds were removed from the 35°F. room and sorted into uniform groups of four similar pieces (four uniform white or front quarters, four uniform dark or hind quarters, four uniform breasts, four uniform packages of thighs, four uniform packages of drumsticks. One of each of the above four pieces in each group was blast frozen at -40°F., one at -20°F., one at 0°F., and one held in a brine

solution at -43°F. for 30 minutes prior to 48 hours in an air blast at -40°F. After the products were held at these various freezing temperatures for forty eight hours they were placed in a 0°F. room for storage.

The brine frozen pieces were first packaged in cryovac bags to eliminate any chance of the brine seeping into the package during immersion. After the pieces were completely frozen in the -40°F. box the cryovac bags were removed and the cryovac overwrap was applied.

Figures 1, 2, 3, 4, and 5 show photographs of each group as they would appear to the preference panel. These photographs were taken soon after the packages were removed from the freezers but there was considerable frosting in the packages making it difficult to see the characteristic differences among packages.

Figure 6 shows a series of pieces after water was applied to the package to remove the frost, however visual characteristic differences were not too apparent. The main distinction noted in these photographs is the distinct whiteness of the brine frozen product.

Figure 1. Turkey quarters (white) frozen at four different temperatures.

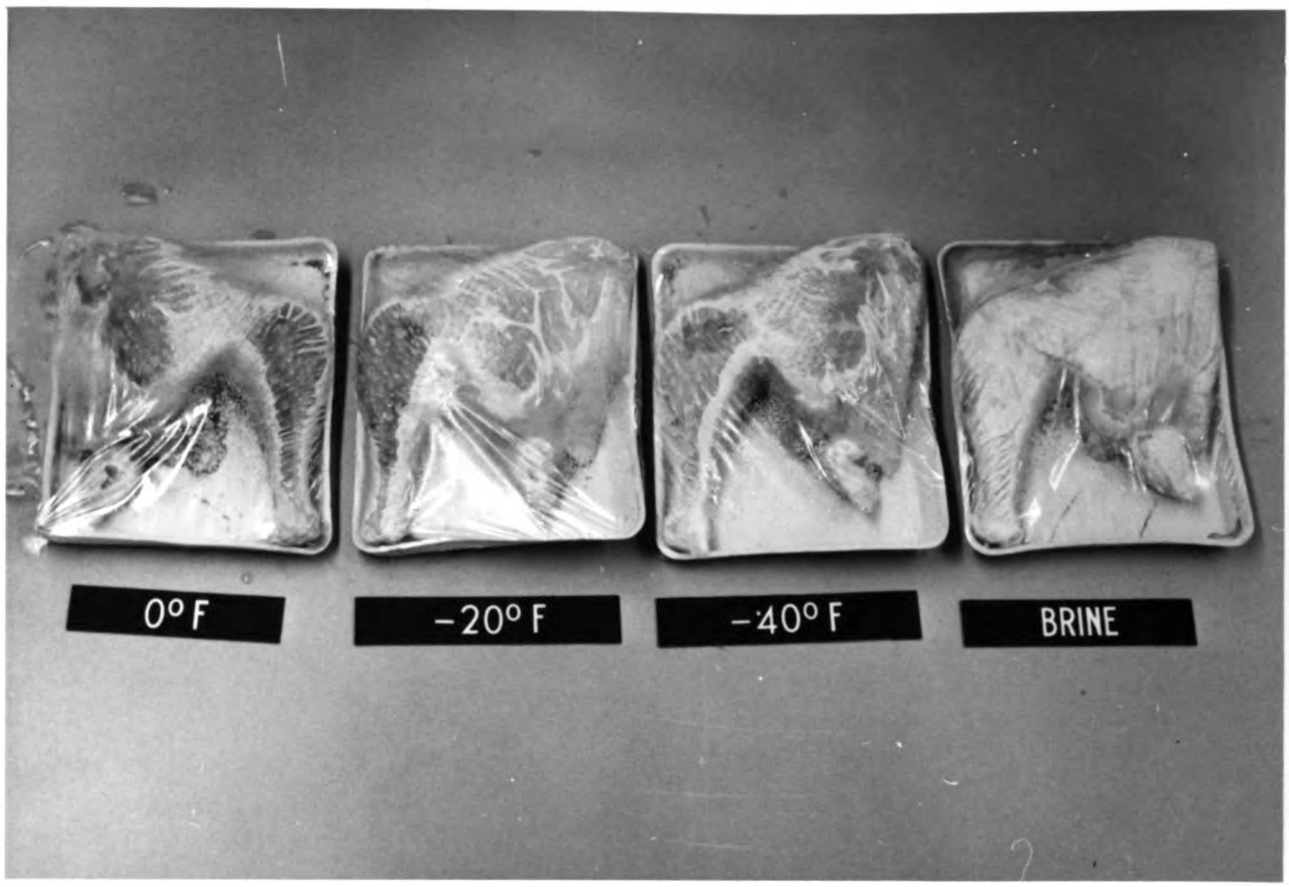

Figure 2. Turkey quarters (dark) frozen at four different temperatures.

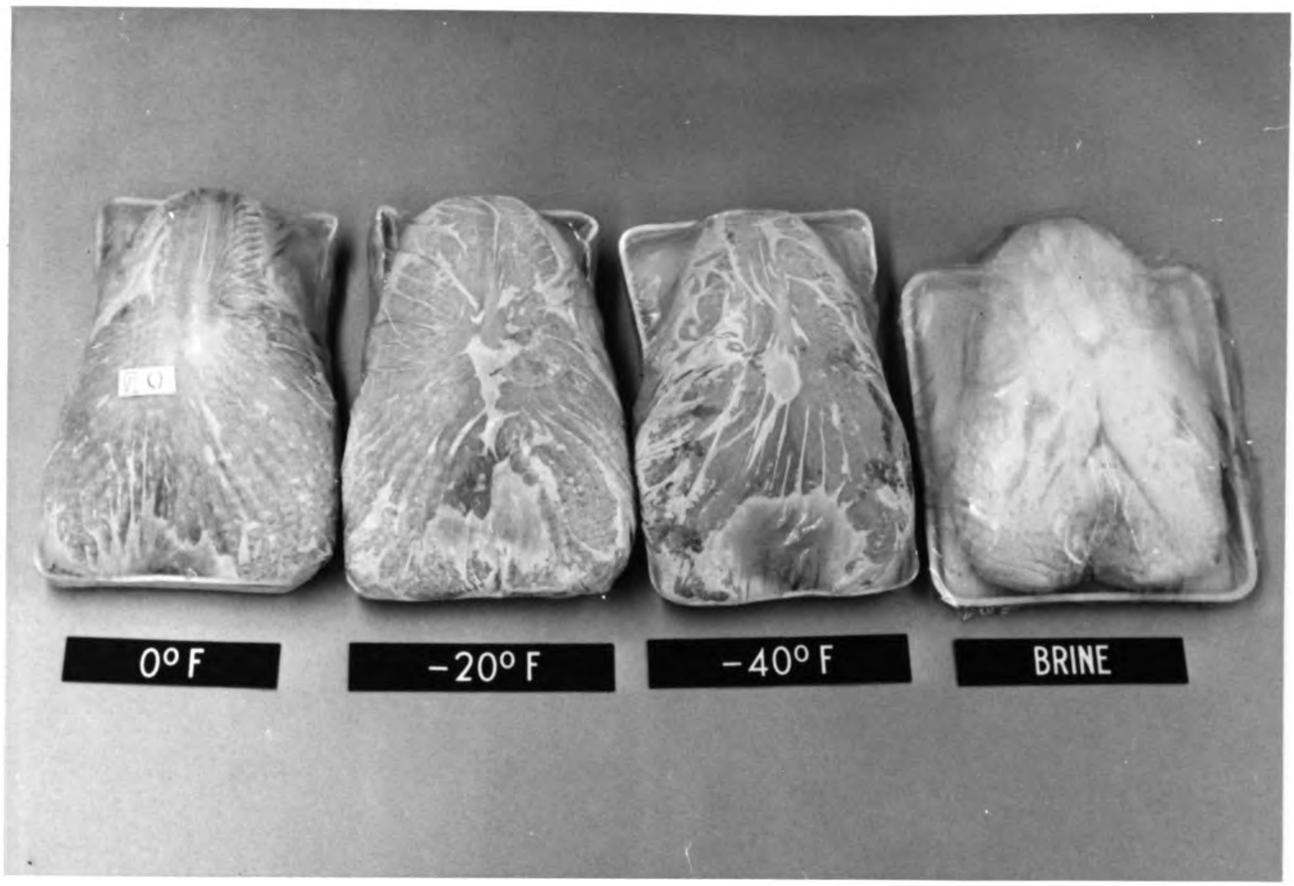

Figure 3. Turkey breasts frozen at four different temperatures.

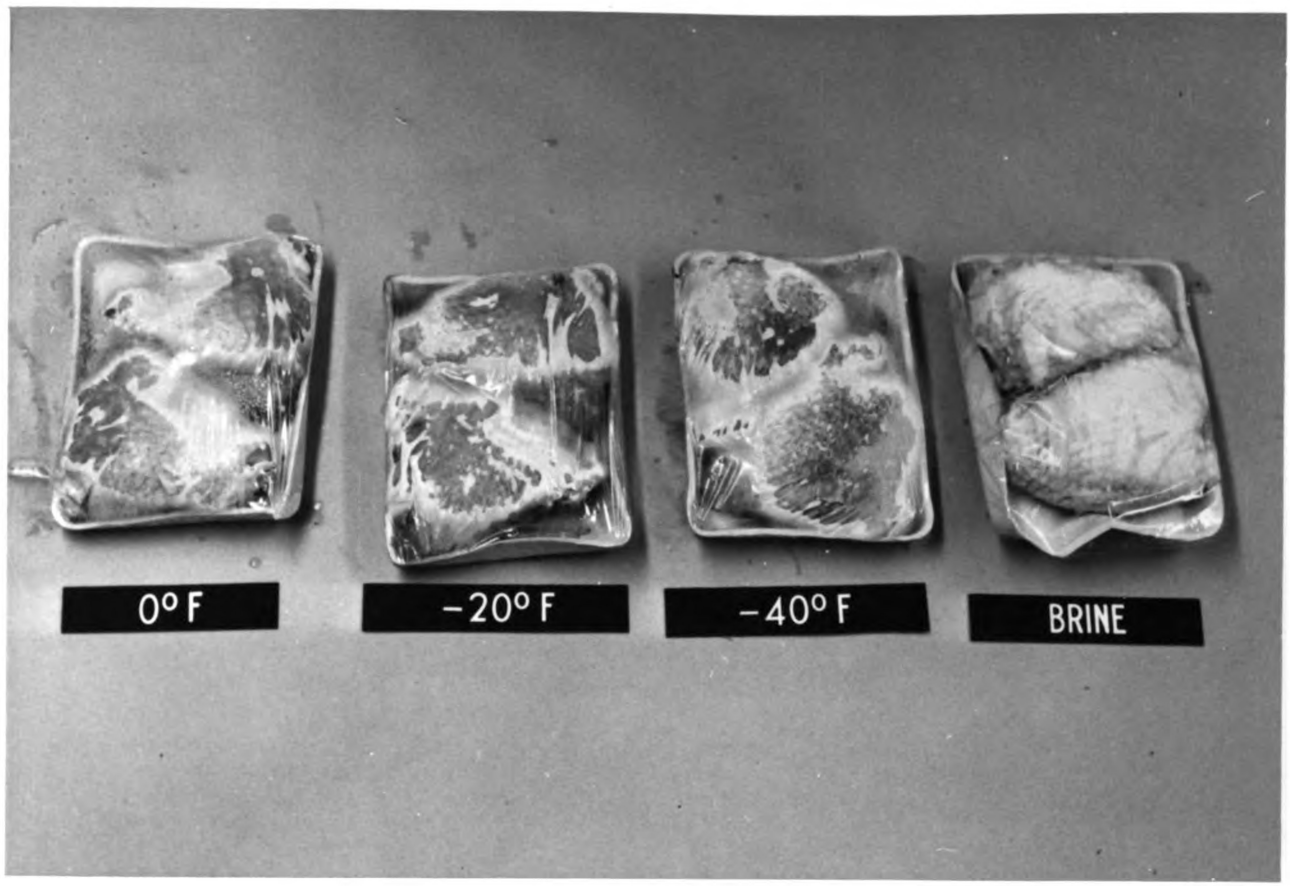

Figure 4. Turkey thighs frozen at four different temperatures.

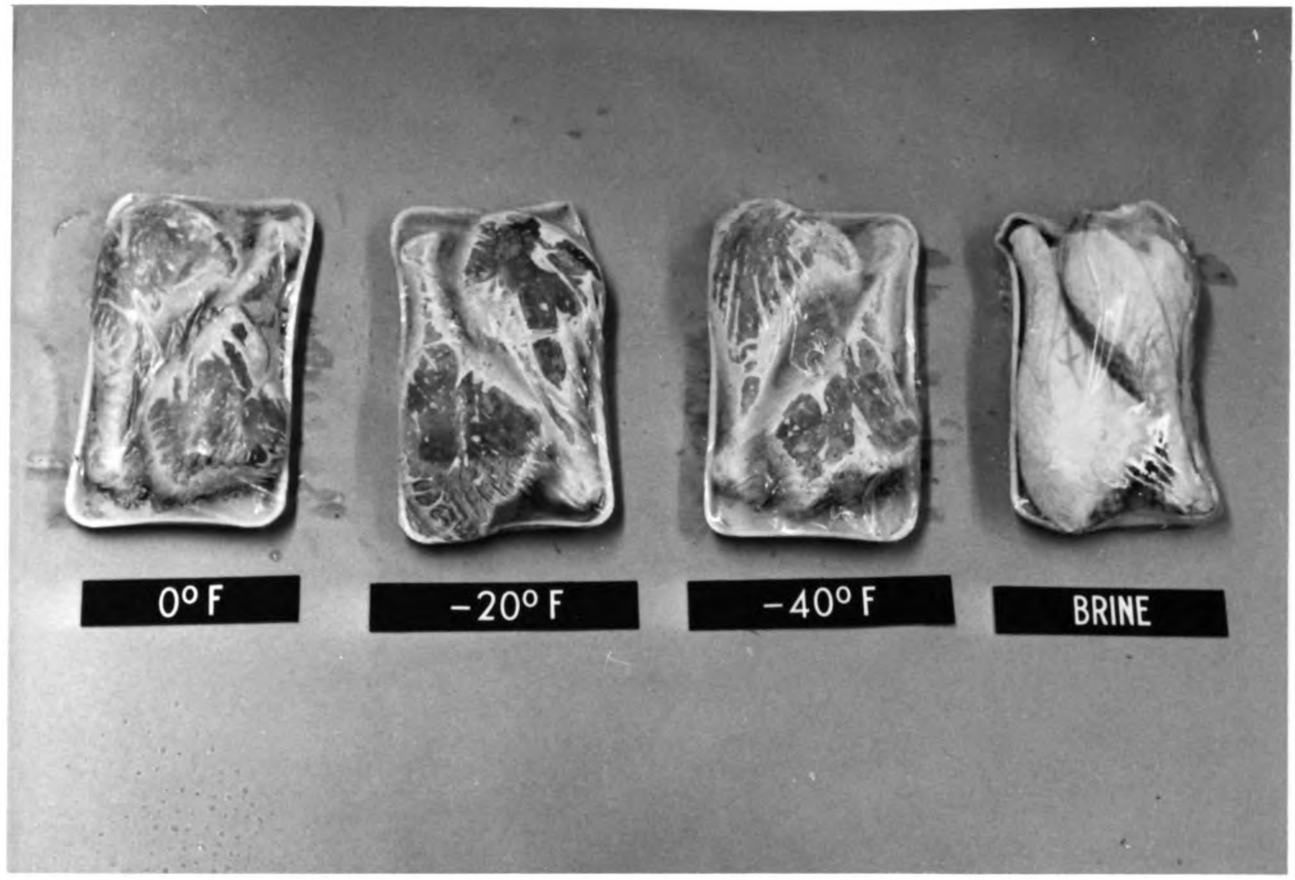

Figure 5. Turkey drumsticks frozen at four different temperatures.

Figure 6. Turkey quarters (white) frozen at four different temperatures, with frost removed before photographing.

B. Packaging Procedure

The day preceding each consumer preference panel meeting in Detroit, a number of Broad Breasted Bronze turkeys were slaughtered and processed to provide the required products for one panel meeting. The slaughtering and processing was similar to that outlined previously.

Four packaging materials were tested in this study (1) Saran (2) Cryovac (3) Polyethylene and (4) Cellophane.

Description of Materials[1]

Polyethylene (Manufactured by various companies) The inherent properties of polyethylene make it an excellent packaging medium. It has low levels of taste and odor, low water absorbancy and a good level of moistureproofness. It is tough, durable and chemically inert. It has inherent flexibility even at extremely low temperatures, which has led to its use in frozen food packaging.

In general the film is characterized by extreme toughness and rubberiness and by excellent electrical properties. Films from different producers show transparency variations, but the film can be made with only slight haziness in the thin gauges.

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[1] Modern Packaging Encyclopedia (1956).

Polyethylene film is insensitive to water and many common solvents and chemicals; however, it is penetrated and softened by many types of fats and oils. Its resistance to the transmission of water vapor is good but it readily transmits oxygen, solvent vapors and many aromatic materials.

Cellophane Cellophane manufactured by E. I. du Pont de Nemours & Co. (Inc.) is indeed the most versatile and popular transparent film, combining functional protection with the advantages of transparency and attractiveness at low cost. Its comparative ease of handling and application has contributed to its wide use.

Three-fourths of all domestic cellophane is used in food packaging, the remainder finding packaging application in fields like the tobacco, textile, drug and paper-products industries as well as in fabricated items and industrial uses.

Cellophane consists of a plasticized base sheet (regenerated cellulose) of essential greaseproofness, which can be made water-vaporproof. Cellophane is quite gasproof as long as the film is dry. Gas-transmission rates will increase as the film becomes wet. The cellophane used in this study was an MSAT type[1].

Vinylidene-chloride film (Saran, Cryovac) Vinylidene-chloride film is produced by the extrusion process. It has some outstanding

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[1]Moistureproof, heat sealing, water resistant.

properties and some very significant limitations. It has the lowest water permeability of any of the packaging films. Its gas permeability is also very low making it an excellent film for vacuum or gas packaging. It has exceptionally high tensile strength and together with its other properties, this permits the use of thin gauges. It is highly flexible and completely transparent.

Vinylidene-chloride despite its remarkable combinations of properties is not used in high volume in packaging. The major reason apparently is its inertness and static. Saran, manufactured by Dow Chemical Company, is a good example of this type of film. Its clinging properties, so much admired by the housewife, make it difficult to handle on conventional machinery. Also special problems may be encountered in heat sealing, although these are not insurmountable.

Vinylidene-chloride resins have been combined with certain other materials to make a highly oriented thin film Cryovac (Manufactured by the Cryovac Co.) which is particularly useful as a protective covering for irregular shaped objects in frozen food applications. The film is available in tubular form to be shrunk around an inserted product, poultry, picnic hams, etc., by the application of heat. This is known as the "Cryovac" process.

Four uniform white or front quarters, four uniform dark or hind quarters and four uniform breasts were selected from the

processed turkeys. One of each product was packaged with each of the four materials listed above. Every series (four white quarters, etc.) contained a product packaged with each of the four materials to be tested. Pulp type trays were used as a backing material, the size varying according to the size and shape of the products used.

Since Polyethylene used in this study was not heat sealable masking tape was used to seal the package. The Cellophane packages were sealed on the bottom of the package with an electric heat sealer. The temperature required to heat seal Cryovac was very critical but with care the job was satisfactorily completed. Saran did not require special sealing since the material was simply folded across the bottom of the package and pressed together, its inherent clinging properties making a satisfactory seal.

The above packaging procedure was followed prior to each panel meeting with the following exceptions. The breasts in Panel A were replaced by drumsticks in Panel B, by thighs in Panel C, and by wings in Panel D.

Figures 7, 8, 9, and 10 show photographs of the turkey pieces packaged with the various overwraps used in the study. Possibly the only difference that can be seen in these photographs is the slight milkiness of the polyethylene overwrap. Cellophane has a tendency to reflect light at certain angles, however the photographs did not show this phenomenon.

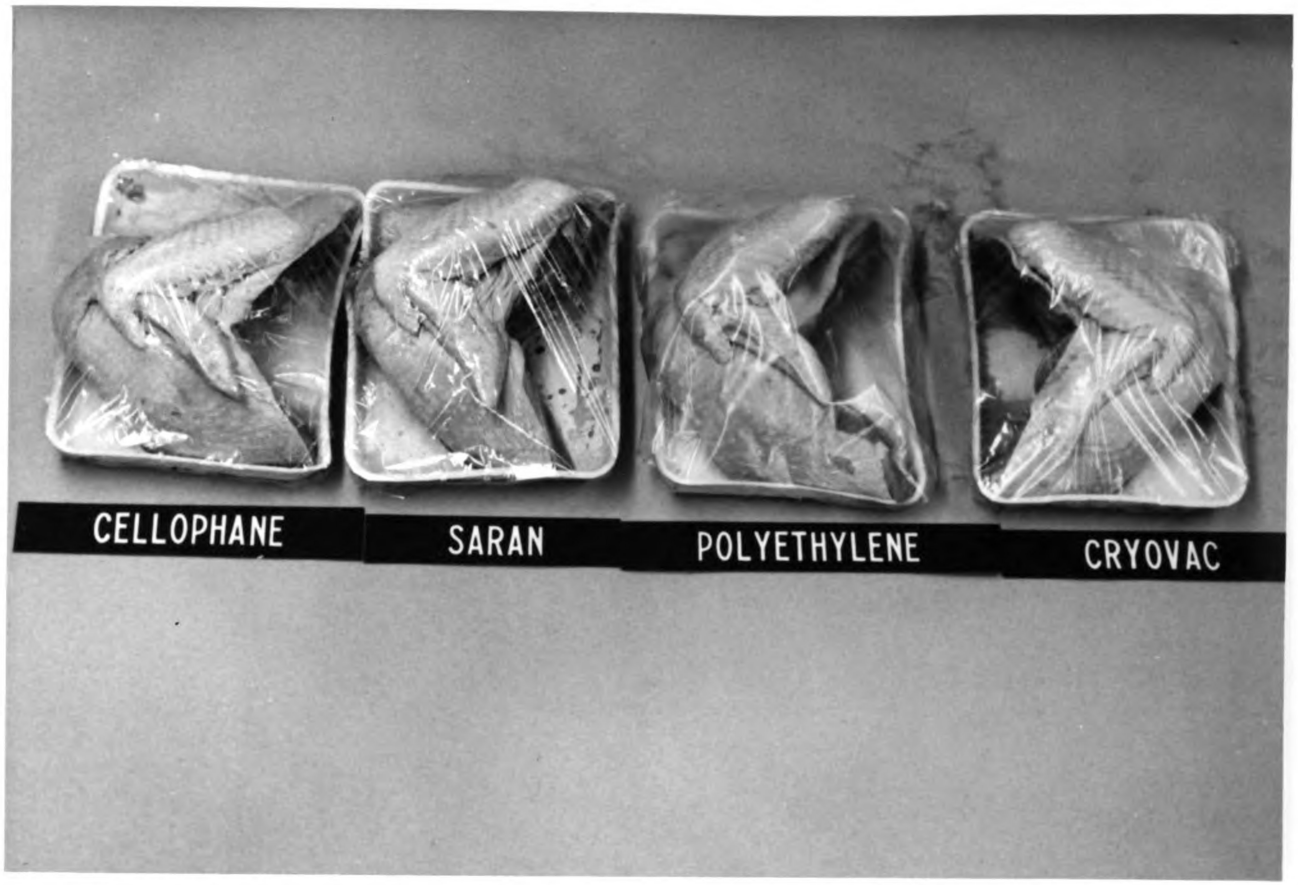

Figure 7. Turkey quarters (white) packaged with four types of packaging material.

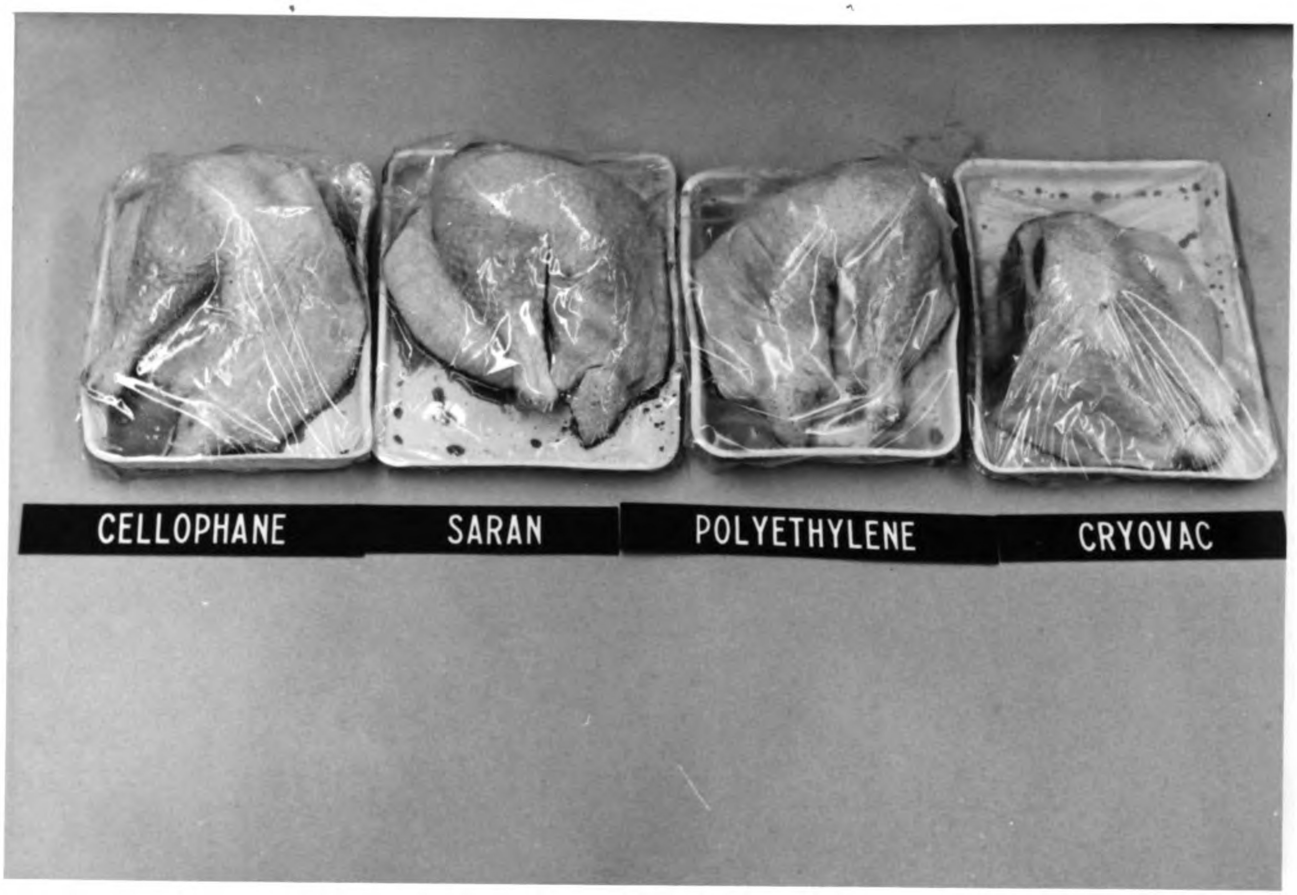

Figure 8. Turkey quarters (dark) packaged with four types of packaging material.

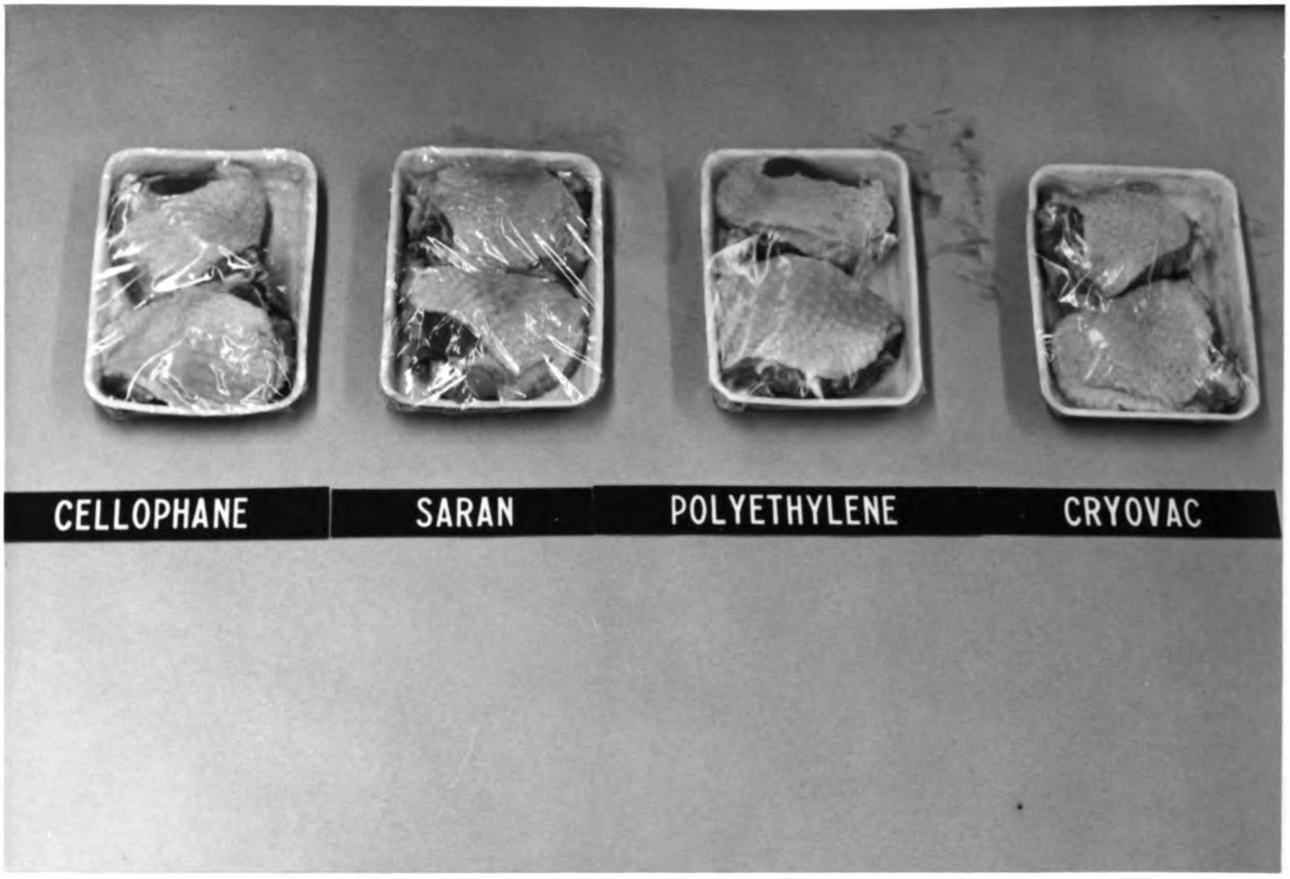

Figure 9. Turkey thighs packaged with four types of packaging material.

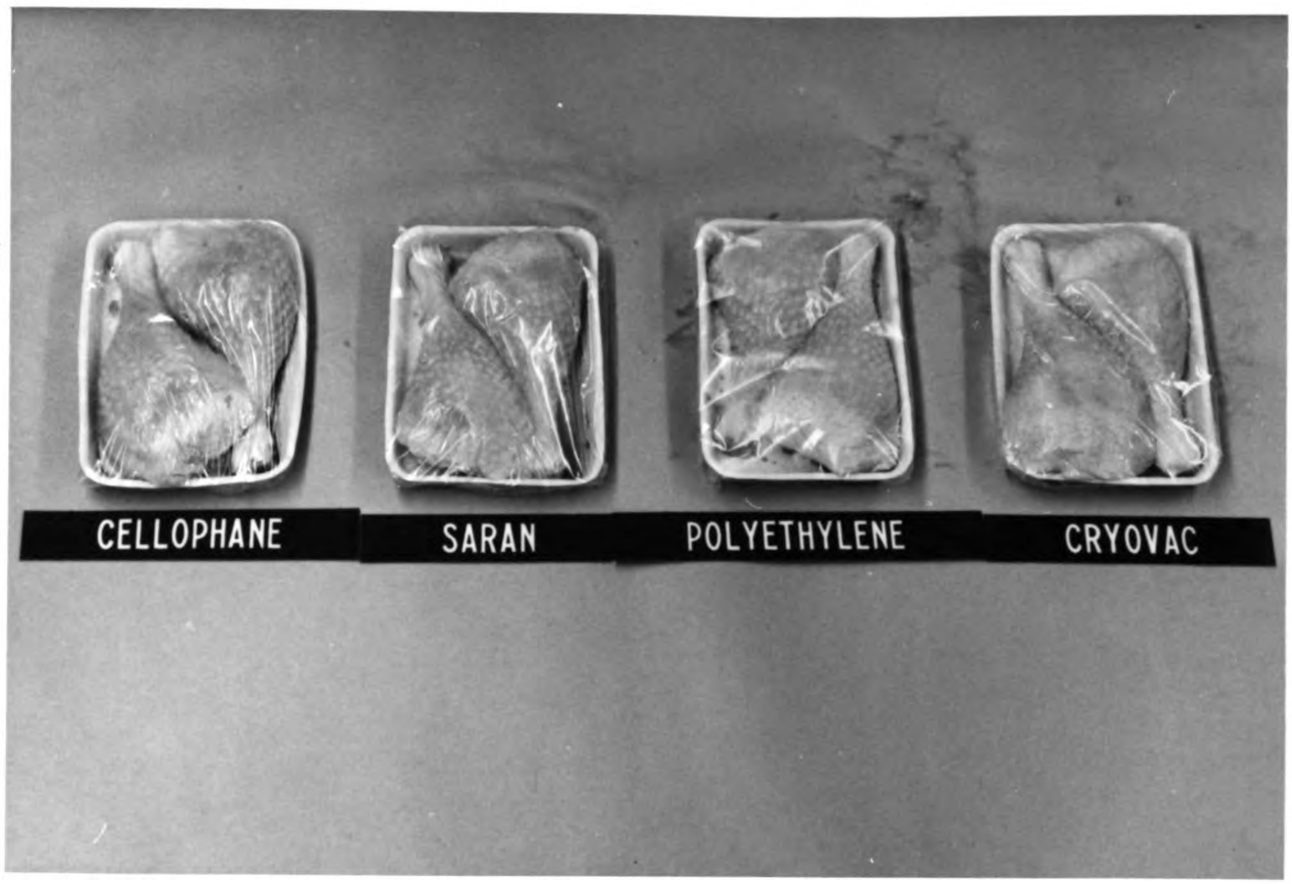

Figure 10. Turkey drumsticks packaged with four types of packaging materials.

C. Panel Procedure

General

The Consumer Preference Panel met in the Home Economics Laboratory at Wayne State University in Nov./57 (Panel A), Dec./57 (Panel B), Feb./58 (Panel C), April/58 (Panel D). Consumer preferences for several agricultural products such as apples, potatoes, pork chops, eggs, poultry and flowers were obtained.

Samples of the turkey products frozen at different temperatures were displayed along with the fresh packaged turkey products on a large table in the Home Economics room. Table I gives the treatments, products and coding used in Panel C which is typical of the four panel meetings.

Panel meetings were conducted from 2:00 p.m. to 4:00 p.m. and from 7:00 p.m. to 9:00 p.m. After a briefing on the general purpose of the project panel members were asked to rank the samples in each series independently of other series. The ranking was to be based on the order in which they would select the various samples if they were buying them, regardless of price.

Symbols were used to identify the actual samples so that numerical or alphabetical order would not influence selection. The symbols were assigned at random to the items so that a particular symbol would not indicate a certain quality or ranking. The positions of

TABLE I

TURKEY PRODUCTS AND THEIR IDENTIFICATIONS EVALUATED
BY PANEL C, DETROIT, 1958

Packaging				Freezing			
Treatment	Series	Products	Symbol	Treatment	Series	Products	Symbol
Saran	I	1 white quarter	()	0°F	IV	1 white quarter	%
Cryovac		1 white quarter	*	-20°F		1 white quarter	()
Cellophane		1 white quarter	#	-40°F		1 white quarter	*
Polyethylene		1 white quarter	%	Brine		1 white quarter	#
Saran	II	1 dark quarter	*	0°F	V	1 dark quarter	()
Cryovac		1 dark quarter	#	-20°F		1 dark quarter	*
Cellophane		1 dark quarter	%	-40°F		1 dark quarter	#
Polyethylene		1 dark quarter	()	Brine		1 dark quarter	%
Saran	III	1 pkg. thighs	#	0°F	VI	1 pkg. thighs	*
Cryovac		1 pkg. thighs	%	-20°F		1 pkg. thighs	#
Cellophane		1 pkg. thighs	()	-40°F		1 pkg. thighs	%
Polyethylene		1 pkg. thighs	*	Brine		1 pkg. thighs	()

the products on display were also varied in order that a product of one treatment would not be placed in a standard position. The symbols as given in Table I were #, %, *, and (). Dry ice was used to refrigerate the frozen products during each panel meeting.

Composition and Selection of the Consumer Panel[1]

Panel members were recruited as follows: Mail questionnaires were sent to about 11,700 names obtained at random from the latest Detroit telephone directory. About 4½% of these were returned by the post-office for non-delivery. About 20% of the remainder were filled out and returned either from the first or the follow-up questionnaire.

The basic questions asked concerned age group, education group, income group, and willingness to come to a display room in Detroit to rank the samples of the different products displayed. As can be seen in Table II most of the panel members who were invited to attend the sessions in November, December, and February, had incomes from $4,000 to $10,000, had received a high school education and were in the 31-45 age group.

Most of the panel was selected with these characteristics because more of the returned questionnaires came from people in these brackets than from any of the others.

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[1] Greig and Larzelere.1957.

TABLE II

CHARACTERISTICS OF CONSUMER PREFERENCE PANEL MEMBERS

Age	Nov./57	Dec./57	Feb./58	April/58	Total	%
			Number of Persons			
Under 30	0	0	0	2	2	.4
31-45	91	108	89	91	379	81.3
46-60	31	19	27	5	82	17.6
Over 60	1	1	0	1	3	.6
Formal Education						
0-8 years	7	5	6	3	21	4.5
9-11 years	26	27	26	29	108	23.2
12-13 years	63	71	61	57	252	54.1
14 or more	27	25	23	10	85	18.2
Annual Income						
$2000-$4000				14	14	3.0
$4001-$5400	43	50	41	28	162	34.8
$5401-$7000	45	48	49	39	181	38.8
$7001-$10,000	35	30	26	18	109	23.4

Panel members were not invited to participate continually to minimize monotony in evaluations, and because continuous attendance at the panel meetings might make the members non-typical consumers since some of them would acquire knowledge of present standards of quality stimulated by these meetings.

The distribution of the panel members with regard to age, education, and income is not intended to reflect the characteristics of all consumers in the Detroit area. However the panel group can be considered representative of the Detroit families who have the characteristics outlined above. These in turn are typical of a sizable portion of Detroit families as indicated by the following figures from the United States Census (1950): (1) the age group 30-44 in Detroit in 1949 represented 40% of the individuals over 25 in that city; (2) those having completed four years of high school with no additional education in Detroit were 23% of total persons over 25 and (3) 38% of the Detroit families had incomes ranging from $4,000 to $9,999 and it can be estimated that these families had about 55% of the total consumer purchasing power in the city.

RESULTS AND DISCUSSIONS

A. Consumer Preference for Turkey Pieces Frozen at Different Temperatures

Consumer preferences for products frozen at 0°F., -20°F., -40°F. and in brine and held for different lengths of time were

determined by the number of persons selecting that product as their first choice. A summary of the first choices is shown in Tables III and IV. Panel members were asked to rank the products 1-4 according to their preference. A weighted average was then calculated and given as a preference score[1]. Complete ranking and preference scores are included in the Appendix.

Turkey quarters partially frozen in a brine solution (-43°F.) and stored for periods of one and two months at 0°F. were preferred by a majority of the panel members. After a storage period of four months the number of panel members selecting brine frozen quarters as their first choice had declined considerably. After six months of storage only five of the afternoon panel members (9%) selected brine frozen quarters as their first choice and in the evening, only seven members (3%) preferred brine frozen quarters.

Preference for turkey pieces (breasts, drumsticks, thighs) did not follow this same pattern. Turkey pieces frozen in brine were preferred by the least number of members of each panel with the exception of Panel A (afternoon) in which the preference was well distributed among the four pieces displayed.

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[1]The percentage of total first rankings, second rankings, etc., in each test or series was determined for each sample. The percentage for first ranking was multiplied by five for each sample. The percentage for second ranking was multiplied by four, and so on in descending order. These adjusted percentages were added to give a single preference score for that sample.

The highest score in each series indicates the sample that was preferred by the largest number of panel members. The amount of differences between the scores shows the degree of preference for samples.

TABLE III

INFLUENCE OF FREEZING TEMPERATURES AND STORAGE ON CONSUMER PREFERENCES FOR TURKEY QUARTERS AND PIECES

		AFTERNOON			
		Temperatures			
Panel	Products	0°F	-20°F	-40°F	Brine
		Number of first choice selections			
A	Quarters	21	13	13	64
	Pieces	14	16	12	15
B	Quarters	25	22	7	41
	Pieces	4	20	16	8
C	Quarters	19	16	40	10
	Pieces	16	16	12	4
D	Quarters	23	8	17	5
	Pieces	4	3	15	3
	TOTAL Quarters	88	59	77	120
	TOTAL Pieces	38	55	55	30
	GRAND TOTAL	126	114	132	150

TABLE IV

INFLUENCE OF FREEZING TEMPERATURES AND STORAGE
ON CONSUMER PREFERENCES FOR
TURKEY QUARTERS AND PIECES

Panel	Products	EVENING Temperatures 0°F	-20°F	-40°F	Brine
		Number of first choice selections			
A	Quarters	26	32	22	59
	Pieces	35	17	11	7
B	Quarters	33	22	12	104
	Pieces	14	46	17	8
C	Quarters	27	16	66	59
	Pieces	26	43	12	9
D	Quarters	69	42	50	7
	Pieces	30	17	25	12
TOTAL	Quarters	155	112	150	229
TOTAL	Pieces	105	123	65	36
GRAND TOTAL		260	235	215	265

Initially the brine frozen products had an unnatural white appearance, which might be described as frosty-white. However, after four and six months of storage, they appeared dehydrated and chalky. There were also indications of darkening and some severe discolorations around the edges of the product. The author's observations were that these products were not very appealing after the longer storage time.

The procedure followed in packaging the brine frozen products differs somewhat from the methods used in the other packaged products. The brine frozen products being frozen before packaging made it impossible to heat shrink the package. Difficulties were involved in getting a satisfactory seal with the film used and in some cases it was found that during handling the poor seal on the package became more apparent. Refrigeration of the products with dry ice was inadequate and consequently midway through the evening session the products appeared partially thawed. This did not appear to seriously influence the preferences of the panel members. A Chi-square analysis (Table V) showed that there was no significant difference in preferences for turkey quarters between the afternoon and evening panel meetings (all panels combined). Highly significant differences were found in preferences for turkey pieces between afternoon and evening panel meetings,(all panels combined).

TABLE V

CHI-SQUARE ANALYSIS OF THE PREFERENCES FOR PRODUCTS FROZEN AT DIFFERENT TEMPERATURES

Panel	Test	Product	X^2
A	Afternoon vs Evening	Quarters	8.059*
	Afternoon vs Evening	Breasts	10.725**
B	Afternoon vs Evening	Quarters	8.924*
	Afternoon vs Evening	Drumsticks	5.970*
C	Afternoon vs Evening	Quarters	17.175**
	Afternoon vs Evening	Thighs	4.227
D	Afternoon vs Evening	Quarters	3.821
	Afternoon vs Evening	Breasts	7.980*
TOTAL	Afternoon vs Evening	Quarters	.327
	Afternoon vs Evening	Pieces	15.139**

* Significant difference
** Highly significant difference

There was a definite preference pattern for turkey pieces (including quarters) frozen at different temperatures in a blast air freezer (Table VI). The products frozen at -40°F. were ranked last by panels A and B but first by Panels C and D. This indicates that the lower freezing temperatures may be more advisable for turkey which may be held for several months. Products frozen at 0°F. and at -20°F. received higher preference scores than those frozen at -40°F. by Panels A and B and lower scores by Panels C and D. This pointed out the possibility of a relation between the brine frozen products and selection of products frozen at -40°F. Those panel members who preferred a light colored product selected the brine frozen products as their first choice in Panel A and Panel B. However, the brine frozen products used in Panel C and D appeared less desirable, therefore, the products frozen at -40°F., being the next lightest in color, were selected.

Statistical analysis (Table VII) was completed on the first choice selections of the panel members. The differences shown in Tables III and IV among temperatures and among panels was proven to be significant.

B. Influence of Packaging Materials on Preferences for Turkey Pieces

Preferences for turkey pieces packaged with various

TABLE VI

INFLUENCE OF AIR FREEZING TEMPERATURE ON
PREFERENCE FOR TURKEY PRODUCTS
(RANKED ACCORDING TO 1st CHOICE SELECTIONS)

Freezing Temperature	Panel A		B		C		D	
	Aft.	Eve.	Aft.	Eve.	Aft.	Eve.	Aft.	Eve.
	Rank							
0°F	1	1	2	2	2	3	2	1
-20°F	2	2	1	1	3	2	3	3
-40°F	3	3	3	3	1	1	1	2

TABLE VII.

SUMMARY OF CHI-SQUARE ANALYSIS OF PREFERENCES FOR PRODUCTS FROZEN AT DIFFERENT TEMPERATURES

Test	χ^2
Afternoon vs Evening (Quarters)	.327
Afternoon vs Evening (Pieces)	15.139**
Between temperatures (Quarters) afternoon	22.907**
Between temperatures (Pieces) afternoon	10.635*
Between temperatures (Quarters) evening	44.464**
Between temperatures (Pieces) evening	56.073**
Between panels (Quarters) afternoon	95.214**
Between panels (Pieces) afternoon	30.126**
Between panels (Quarters) evening	168.444**
Between panels (Pieces) evening	47.033**

* Significant difference
** Highly significant difference

packaging materials were determined by panel members and evaluated by a comparison of first place choices. The results of this preference study are shown in Table VIII. A more detailed summary of the panel members preferences are included in the Appendix.

Products packaged in polyethylene were ranked first by more panel members than were the products packaged in any one of the other materials. In the combined afternoon panel meetings, 207 members (40.4%) selected the polyethylene packaged product as their first choice. Saran and Cellophane packaged products ranked next since 114 (23.3%) and 113 (22.1%) members respectively selected these as their number one choice. Polyethylene packaged products were preferred by a majority of panel members in all meetings except in the evenings in Panel A and Panel B. In the latter two meetings, it was ranked third and second, respectively. In the combined evening meetings, 374 persons (37.8%) selected Polyethylene as their first choice. The number of first place choices for Cellophane packaged products changed from 114 (22.3%) in the afternoon to 154 (15.6%) in the evening, while the number of persons selecting products packaged in Cryovac increased from 78 (15.2%) to 183 (18.5%) respectively.

TABLE VIII

CONSUMER PREFERENCES FOR TURKEY PIECES WRAPPED WITH VARIOUS PACKAGING MATERIALS

Panel	Materials			
	Saran	Cryovac	Cellophane	Polyethylene
	Number of First Choice Selections			
	Afternoon			
A	57	13	24	71
B	28	19	43	55
C	23	25	32	46
D	6	21	14	35
TOTAL	114	78	113	207
	Evening			
A	60	31	80	38
B	38	48	108	68
C	35	59	36	136
D	21	45	54	132
TOTAL	154	183	278	374

A Chi-square analysis (Table IX) showed that there were significant differences in product preferences between afternoon and evening panel groups, with the exception of Panel D. Significant differences in numbers of first choice selection were also found among panels both in the afternoon and in the evening.

The number of first place choices for the polyethylene packaged products was found to be significantly larger than for products packaged in other materials.

There were indications from the data and from the author's observations that in some cases changes in the appearance of the product occurred between the afternoon and evening panel meetings. These changes were primarily in color and apparent dryness and were not considered to be severe changes. There was a possibility that these changes could have affected the preferences of the panel members from afternoon to evening.

Since panel meetings were held both in the afternoon and evening, the use of artificial light as compared to some natural light could have also influenced the selection of products by the preference panel members.

There was considerable difficulty involved in selecting products for uniformity for this study. However, since both the products and people were selected at random, any slight product differences present would not have affected the total results.

TABLE IX

SUMMARY OF CHI-SQUARE ANALYSIS ON PREFERENCE FOR PRODUCTS PACKAGED WITH DIFFERENT PACKAGING MATERIALS

	Test	χ^2 Value
(1)	Between afternoon and evening groups[1]	15.870**
(2)	Among panel meetings (afternoon)[2]	45.438**
(3)	Among panel meetings (evening)[3]	141.596**
(4)	Among packaged products (afternoon)[4]	71.576**
(5)	Among packaged products (evening)[5]	120.78**

**Highly significant differences

[1]Afternoon panel members did not agree with evening panel members in their preference. The rank in preference for first choice was reversed by two panels.

[2]Afternoon panels did not always agree with each other in their preference for a particular packaging material.

[3]Evening panels did not always agree with each other in their preference for a particular packaging material.

[4]Polyethylene was significantly higher than all others.

[5]Polyethylene was significantly higher than all others.

CONCLUSIONS

1. Turkey quarters partially frozen in a brine solution were preferred over quarters frozen in an air blast freezer at 0°F, -20°F. and -40°F. after storage periods of one and two months at 0°F. After longer storage periods (four and six months) the preference for brine frozen quarters was significantly lower and the products frozen at -40°F. in air were preferred.
2. Preference for turkey pieces (breasts, drumsticks, thighs) did not follow the same pattern as for turkey quarters. This difference may have been influenced by the package shape, since a larger surface area of the turkey quarters was in close contact with the brine during freezing and a more uniform color in the frozen product resulted. Pieces frozen in air at -20°F. and -40°F. were equally preferred by the 4 panels combined, followed by those frozen at 0°F. and in brine respectively.
3. The temperature of the brine solution (-43°F) gave the products an unnatural white appearance which was accentuated by long (4 months) periods of storage.
4. Turkey products which are to be stored for long periods of time (six months or over) should be frozen at temperatures below -20°F. for maximum consumer preference.
5. Turkey quarters and pieces packaged with polyethylene were preferred by a majority of consumer preference panel members. Reasons for this preference were not determined in this study. Cellophane packaged products were ranked second in number of first choice selections.

APPENDIX

TABLE I

CONSUMER PREFERENCE FOR TURKEY QUARTERS PACKAGED WITH VARIOUS OVERWRAPS
PANEL A, SERIES 1

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	29	12	11	1	51.8	413.8
Cryovac	0	4	4	44	0	239.1
Cellophane	18	20	14	1	32.2	390.0
Polyethylene	9	18	23	3	16.1	356.1
			EVENING			
			Number of Selections			
Saran	20	29	15	4	27.0	387.1
Cryovac	5	4	7	52	6.9	251.0
Cellophane	31	25	13	1	43.1	422.3
Polyethylene	16	10	34	7	22.2	339.5

TABLE II

CONSUMER PREFERENCE FOR TURKEY QUARTERS PACKAGED WITH VARIOUS OVERWRAPS
PANEL A, SERIES 2

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	2	20	10	21	3.8	296.8
Cryovac	2	22	18	11	3.8	313.1
Cellophane	3	20	17	13	5.7	313.6
Polyethylene	46	3	4	0	86.8	477.0
			EVENING			
			Number of Selections			
Saran	1	12	18	34	17.6	268.2
Cryovac	4	18	23	21	26.5	306.2
Cellophane	7	34	21	4	50.0	358.4
Polyethylene	56	4	5	3	5.9	467.7

TABLE III

CONSUMER PREFERENCE FOR TURKEY BREASTS PACKAGED
WITH VARIOUS OVERWRAPS
PANEL A, SERIES 3

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	26	16	9	2	46.4	411.8
Cryovac	11	19	18	5	19.6	363.2
Cellophane	3	5	12	33	5.4	264.4
Polyethylene	16	13	14	10	28.6	360.0
			EVENING			
			Number of Selections			
Saran	27	28	7	5	40.6	402.6
Cryovac	8	8	33	18	11.6	308.8
Cellophane	3	15	12	37	21.7	276.7
Polyethylene	32	18	14	5	26.1	411.9

TABLE IV
CONSUMER PREFERENCE FOR TURKEY QUARTERS FROZEN
AT VARIOUS TEMPERATURES
PANEL A, SERIES 4

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	13	26	11	2	23.6	377.6
-20°F	10	14	9	20	18.2	325.0
-40°F	4	10	23	16	7.3	310.1
Brine (-43°F)	28	6	7	12	50.9	387.3
			EVENING			
			Number of Selections			
0°F	18	22	9	18	25.7	351.1
-20°F	21	16	20	11	30.0	364.8
-40°F	13	12	28	15	18.6	332.4
Brine (-43°F)	18	19	11	21	25.7	351.7

TABLE V

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL A, SERIES 5

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	8	25	16	4	14.3	361.1
-20°F	3	17	12	10	5.4	303.6
-40°F	9	8	23	13	16.07	324.1
Brine (-43°F)	36	5	2	10	64.28	411.9
	EVENING Number of Selections					
0°F	8	25	25	9	11.6	344.3
-20°F	11	19	16	21	15.9	326.4
-40°F	9	14	14	30	13.1	301.1
Brine (-43°F)	41	10	12	6	59.4	427.7

TABLE VI

CONSUMER PREFERENCE FOR TURKEY BREASTS
FROZEN AT VARIOUS TEMPERATURES
PANEL A, SERIES 6

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	14	20	11	8	24.6	370.0
-20°F	16	12	16	9	28.1	360.1
-40°F	12	15	19	7	21.1	356.8
Brine (-43°F)	15	6	6	25	26.3	313.2
	EVENING Number of Selections					
0°F	35	15	12	5	50.0	407.5
-20°F	17	19	17	14	24.3	352.3
-40°F	11	17	21	20	15.7	334.0
Brine (-43°F)	7	17	17	26	10.0	306.2

TABLE VII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL B, SERIES 1

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	10	13	11	13	20.8	337.7
Cryovac	9	13	14	12	18.8	342.2
Cellophane	19	17	7	4	39.6	400.8
Polyethylene	10	5	16	17	20.8	319.5
	EVENING Number of Selections					
Saran	10	14	25	31	11.5	308.4
Cryovac	14	27	25	14	16.1	348.0
Cellophane	50	15	11	3	57.5	411.8
Polyethylene	13	26	16	25	15.0	332.1

TABLE VIII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL B, SERIES 2

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	13	8	12	15	27.1	340.9
Cryovac	7	14	13	14	14.6	329.5
Cellophane	14	15	12	6	29.2	369.4
Polyethylene	14	12	11	11	29.2	360.5
	EVENING Number of Selections					
Saran	14	16	20	27	15.7	318.9
Cryovac	29	13	24	12	32.6	360.0
Cellophane	18	29	19	12	20.2	364.1
Polyethylene	28	17	14	19	31.5	357.1

TABLE IX

CONSUMER PREFERENCE FOR TURKEY DRUMSTICKS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL B, SERIES 3

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	5	10	10	23	10.2	298.8
Cryovac	3	3	27	15	6.1	285.9
Cellophane	23	23	11	3	20.4	373.2
Polyethylene	12	12	2	3	63.3	442.1
			EVENING			
			Number of Selections			
Saran	14	30	18	17	16.3	348.3
Cryovac	5	11	28	35	5.8	289.2
Cellophane	40	17	16	6	46.5	396.5
Polyethylene	27	22	15	15	31.4	366.5

TABLE X

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL B, SERIES 4

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	10	20	13	4	20.8	367.7
-20°F	20	12	10	6	41.7	395.7
-40°F	3	8	17	20	6.3	289.4
Brine (-43°F)	15	8	9	16	31.3	348.1
			EVENING			
			Number of Selections			
0°F	11	25	31	13	12.8	344.2
-20°F	18	33	18	11	20.9	371.1
-40°F	6	8	18	48	7.0	271.0
Brine (-43°F)	51	12	12	4	59.3	414.3

TABLE XI

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL B, SERIES 5

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	15	23	6	3	31.9	403.1
-20°F	2	9	13	23	4.3	281.6
-40°F	4	10	24	8	8.5	317.1
Brine (-43°F)	26	6	3	12	55.3	398.2
			EVENING			
			Number of Selections			
0°F	22	42	13	3	25.9	396.4
-20°F	4	11	16	49	4.7	269.3
-40°F	6	15	43	16	7.1	314.7
Brine (-43°F)	53	12	8	7	62.4	420.6

TABLE XII

CONSUMER PREFERENCE FOR TURKEY DRUMSTICKS
FROZEN AT VARIOUS TEMPERATURES
PANEL B, SERIES 6

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	4	13	22	8	8.3	327.5
-20°F	20	11	9	7	41.7	396.2
-40°F	16	19	9	3	33.3	364.0
Brine (-43°F)	8	4	7	28	16.7	263.5
			EVENING			
			Number of Selections			
0°F	14	41	21	2	16.5	377.3
-20°F	46	11	10	11	54.1	396.2
-40°F	17	21	39	1	20.0	364.0
Brine (-43°F)	8	7	5	58	9.4	263.5

TABLE XIII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL C, SERIES 1

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	8	15	7	6	19.04	368.4
Cryovac	10	9	7	10	23.80	345.6
Cellophane	8	6	9	13	19.04	321.3
Polyethylene	16	4	11	5	38.09	364.3
	EVENING Number of Selections					
Saran	14	27	29	11	15.90	350.5
Cryovac	21	13	18	29	23.86	329.0
Cellophane	10	18	25	28	11.36	314.7
Polyethylene	43	25	6	7	48.86	406.6

TABLE XIV

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL C, SERIES 2

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	9	6	5	15	21.42	317.7
Cryovac	3	4	16	11	7.14	294.0
Cellophane	19	5	8	4	45.23	382.3
Polyethylene	11	18	5	2	26.19	405.7
	EVENING Number of Selections					
Saran	11	16	27	27	12.35	315.4
Cryovac	15	30	26	10	16.85	358.6
Cellophane	17	12	18	34	19.10	313.6
Polyethylene	46	22	9	4	51.68	413.0

TABLE XV

CONSUMER PREFERENCE FOR TURKEY THIGHS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL C, SERIES 3

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	6	5	4	21	14.28	289.3
Cryovac	12	15	8	1	28.57	395.7
Cellophane	5	6	15	10	11.90	321.0
Polyethylene	19	8	7	2	45.23	393.6
			EVENING			
			Number of Selections			
Saran	10	26	20	25	11.23	327.3
Cryovac	23	27	22	8	25.84	363.6
Cellophane	9	17	24	31	10.11	311.1
Polyethylene	47	14	13	6	52.80	397.5

TABLE XVI

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL C, SERIES 4

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	9	14	10	2	20.45	370.8
-20°F	6	10	16	4	13.63	356.1
-40°F	24	8	4	0	54.54	402.8
Brine (-43°F)	5	2	3	26	11.36	270.5
			EVENING			
			Number of Selections			
0°F	9	43	18	11	10.97	355.0
-20°F	9	12	33	27	10.97	304.5
-40°F	49	15	11	6	59.75	427.0
Brine (-43°F)	15	14	19	33	18.29	314.6

TABLE XVII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL C, SERIES 5

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	10	7	17	2	24.39	363.8
-20°F	10	13	8	5	24.39	370.3
-40°F	16	9	9	2	39.02	389.1
Brine (-43°F)	5	6	0	25	12.19	276.4
	EVENING Number of Selections					
0°F	18	34	20	9	20.93	365.3
-20°F	7	18	28	28	8.13	307.6
-40°F	17	19	19	26	19.76	331.2
Brine (-43°F)	44	14	11	12	51.16	396.3

TABLE XVIII

CONSUMER PREFERENCE FOR TURKEY THIGHS
FROZEN AT VARIOUS TEMPERATURES
PANEL C, SERIES 6

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	16	8	10	2	33.33	382.9
-20°F	10	21	5	0	33.33	409.1
-40°F	12	4	16	3	25.00	346.1
Brine (-43°F)	4	1	4	27	8.33	262.1
	EVENING Number of Selections					
0°F	26	19	31	4	28.88	367.5
-20°F	43	21	10	7	47.77	401.7
-40°F	12	35	28	4	13.33	358.1
Brine (-43°F)	9	5	11	55	10.00	273.8

TABLE XIX

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL D, SERIES 1

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	3	4	7	11	11.5	298.3
Cryovac	6	9	5	5	23.1	357.9
Cellophane	6	7	6	6	23.1	348.1
Polyethylene	11	6	6	2	42.3	395.5
	EVENING Number of Selections					
Saran	12	22	25	25	14.3	325.3
Cryovac	18	30	23	13	21.4	363.0
Cellophane	33	17	13	21	39.3	373.8
Polyethylene	21	15	23	25	25.0	338.4

TABLE XX

CONSUMER PREFERENCE FOR TURKEY QUARTERS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL D, SERIES 2

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
Saran	2	2	11	10	8.0	284.0
Cryovac	1	5	10	9	4.0	292.0
Cellophane	8	9	4	4	32.0	384.0
Polyethylene	14	9		2	56.0	440.0
	EVENING Number of Selections					
Saran	9	19	32	24	10.7	315.4
Cryovac	3	24	29	28	3.6	302.5
Cellophane	17	24	17	26	20.2	338.0
Polyethylene	55	17	6	6	65.5	443.8

TABLE XXI

CONSUMER PREFERENCE FOR TURKEY WINGS
PACKAGED WITH VARIOUS OVERWRAPS
PANEL D, SERIES 3

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
Saran	1	3	11	10	4.0	280.0
Cryovac	14	8	2	1	56.0	440.0
Cellophane		3	9	13	0	260.0
Polyethylene	10	11	3	1	40.0	420.0
			EVENING			
			Number of Selections			
Saran		5	24	55	0	240.8
Cryovac	24	48	9	3	28.6	410.7
Cellophane	4	10	47	23	4.8	294.4
Polyethylene	56	21	4	3	66.7	455.1

TABLE XXII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL D, SERIES 4

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
			AFTERNOON			
			Number of Selections			
0°F	18	3	3	1	64.3	417.4
-20°F	7	9	6	3	25.0	375.0
-40°F	2	10	12	1	7.1	360.7
Brine (-43°F)	1	2	3	19	3.6	247.1
			EVENING			
			Number of Selections			
0°F	45	27	12		53.6	439.3
-20°F	28	32	17	7	33.3	396.3
-40°F	10	22	51	1	11.9	348.8
Brine (-43°F)	1	3	4	75	1.2	215.6

TABLE XXIII

CONSUMER PREFERENCE FOR TURKEY QUARTERS
FROZEN AT VARIOUS TEMPERATURES
PANEL D, SERIES 5

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	5	11	7	2	20.0	371.1
-20°F	1	2	17	5	4.0	284.4
-40°F	15	8	2		60.0	450.2
Brine (-43°F)	4	4	1	16	16.0	294.3
	EVENING Number of Selections					
0°F	24	29	24	7	28.6	380.6
-20°F	14	13	32	25	16.7	319.2
-40°F	40	33	8	3	47.6	427.5
Brine (-43°F)	6	11	20	47	7.1	272.7

TABLE XXIV

CONSUMER PREFERENCE FOR TURKEY BREASTS
FROZEN AT VARIOUS TEMPERATURES
PANEL D, SERIES 6

Treatment	Placings 1	2	3	4	% First Choice	Preference Score
	AFTERNOON Number of Selections					
0°F	4	9	5	7	16.0	334.0
-20°F	3	7	12	3	12.0	338.6
-40°F	15	7	3		60.0	441.1
Brine (-43°F)	3	4	4	14	12.0	285.9
	EVENING Number of Selections					
0°F	30	15	31	8	35.7	378.8
-20°F	17	27	27	13	20.2	356.2
-40°F	25	32	21	6	29.8	389.9
Brine (-43°F)	12	10	6	56	14.3	275.4

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