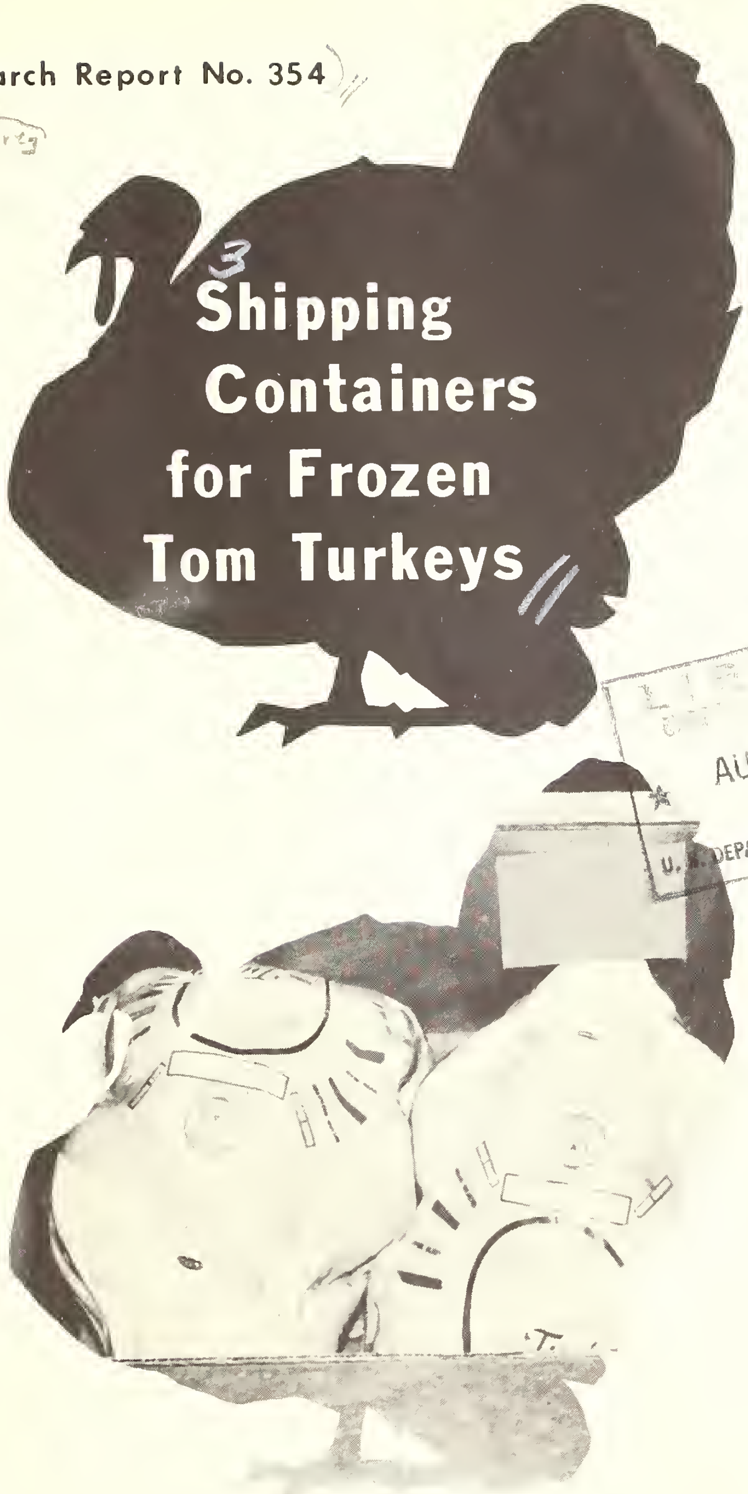
Marketing Research Report No. 354

Shipping Containers for Frozen Tom Turkeys



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U. S. DEPARTMENT OF AGRICULTURE

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SUMMARY

More than 800 shipping containers packed with 18- to 22-pound frozen eviscerated tom turkeys were moved by truck more than 3,000 miles from California to New York City in 5 test shipments. Found to be factors of prime importance in protecting the product and preventing damage to containers were: size and shape of container, how the product fit in the container, stacking strength, and construction design, along with the care and skill used in processing and handling at the processing plant and at the receiving end. About 29 percent of the experimental containers received slight to moderate damage. There was no product damage, and only 42 of the 400 turkeys inspected showed damage to their film wrappers. The damage was minor--primarily breaks in the film in the hock, thigh, and breast areas.

The containers with the least damage were those with a tight, firm pack and strong structural design, with $\frac{1}{4}$-inch to 1-inch headroom or space between the top surface of the turkeys and the top of the box. The containers with the most damage were all too big for the 18- to 22-pound turkeys, and therefore had excessive headroom and a high percentage of concave tops.

Of five container types tested, a full-telescope box with cutaway sides and ends, reinforced with corner posts, showed the least damage. The fiberboard strength was 275 pounds per square inch for the body of the container and 200 pounds per square inch for the cover. The pack was tight, and headroom measurements ranged from less than $\frac{1}{4}$ to 3/4 inch. More than 95 percent of these containers had $\frac{1}{2}$ inch or less of headroom. There was no product damage, and only 8 of the 80 turkeys inspected showed minor damage to the film wrappers.

The container sustaining the most damage was another full-telescope fiberboard box of lighter material and with vents in both sides and ends. Fiberboard strength was 200 pounds per square inch for both body and cover. The container was too deep for the turkeys, and the headroom measured from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches. Of the 147 containers of this type tested, 70 showed moderate damage and 27 slight damage. Of 80 turkeys inspected, 13 had film damage.

Although the full-telescope container received the least damage, creased and scuffed less and looked fresher at the receiving end, it was the most expensive container. In contrast, the cheapest container--a one-piece fiberboard box--received the second lowest incidence of damage and, although it creased and scuffed more, there was no product damage. It received the most favorable comments from the warehousemen. The price differential between this container and the full-telescope type was 30 cents per unit, or $240 for an average truckload of 800 containers. Extra protection against rough handling, combined with excellent container appearance, may be important to some processors, but to the industry as a whole, savings in costs are of prime importance as long as the container adequately protects the product.

The highest incidence of damage occurred among the containers stacked nearest the rear of the trailer. Containers in the six layers nearest the trailer floor were more frequently damaged than the top two layers.

SHIPPING CONTAINERS FOR FROZEN TOM TURKEYS

By
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INTRODUCTION

Need for Study

Turkey production in the United States has increased steadily in recent years and is now around a billion pounds, live weight, annually. Two-thirds of this quantity is slaughtered and dressed in the September-December period for the peak Thanksgiving and Christmas trade. Some turkeys are marketed fresh, but most are frozen at the time of processing. Turkeys not sold over the holidays are put into storage for sale early in the new year when slaughtering is extremely light.

Many turkeys are hauled long distances to market. For example, California and Minnesota producers do a heavy volume of business in New York City. Turkeys require sturdy, well designed containers that can withstand the rigors of storage in high stacks that will not tip or collapse, and of long, jolting shipments.

There is also a need for container standardization. A preliminary survey of 10 processing plants and 10 cold storage warehouses showed 69 different containers in general use. No two had the same dimensions, and they varied widely in design, strength of board, number of walls, and type of closure.

Among this multiplicity of containers, researchers found packs that were too loose, packs in which the contents seemed to have no relation to the size and shape of the container, and packs that were too heavy for one man to lift. Turkey processors, warehousemen, and haulers agreed that a container that would permit a good fit for the contents was seriously needed. Ill-fitting, weak containers have resulted in much damage not only to the containers but also to the turkeys in them.

Some experienced warehousemen have complained that many shipping containers for turkeys fail to meet the most fundamental requirement of a good container; that is, to protect its contents from damage. One of the most common elements in which a container fails is in stacking strength. The stack stability of a container is important particularly when containers are stacked 16 or more high in storage. Under such conditions, a weak container will break down or collapse, causing stacks to lean or fall, with resulting damage to the product and unnecessary problems and expense to the warehousemen.

A container too big for its contents is not only liable to break down and collapse, but it also wastes warehousing space. For example, containers that are 1 inch too deep may quickly use up one foot of extra space vertically, an unnecessary and expensive loss of storage capacity. The shape of the container also is important for effective stacking, palletizing, and tying-in.

This study was undertaken to help provide container manufacturers and turkey processors with information helpful in selecting and developing containers, at the lowest possible cost, that will effectively protect the product and minimize the marketing problems in handling, moving, and storing frozen turkeys. An economic evaluation was made of five conventionally used containers, selected in the preliminary survey, varying in size, strength, shape, construction, design, and cost.

How Research was Conducted

On the basis of the information obtained in the preliminary survey, five types of containers in the popular 18- to 22-pound tom turkey size group were selected for evaluation. The containers were used by well known processors throughout the country and appeared to be among the strongest containers observed in cold storage. Weaker containers might be expected to show progressively greater damage to both container and contents.

The 18- to 22-pound tom turkey size group was selected because it was representative of the heavier weight and size group in all producing and processing areas. In this size group, the preliminary survey had revealed strong evidence of container problems, with wide variations in size and shape of containers.

A modern plant, with high quality standards, located in the heart of the California turkey-producing area, was selected to pack and ship the experimental containers.

To obtain realistic and rigid test conditions, turkeys were moved through regular marketing channels by truck from California to New York City. To increase further the effectiveness of the test, the experimental containers were loaded in the part of the truck which gives the roughest ride--the area over the tandem wheels and extending to the rear of the truck.

Each container was assigned a code identity. The codes were A, B, C, D, and E, and the containers were identified throughout the experiment by these designations. The codes are used throughout this report when referring to the different containers.

The test shipments included 138 A containers, 147 B containers, 182 C containers, 178 D containers, and 176 E containers.

In each of the five truck shipments, the container locations in the load were rotated in such a way that each of the five types of containers rode once in each of five selected positions. 1/ The positions in the load were numbered 1 to 5, starting with the stack over the tandem wheels and extending back to the rear of the truck. Each stack extended from side to side in the truck trailer and was 8 containers high.

By shipment, the different container types were located in the truck as follows:

Position in truck	First shipment	Second shipment	Third shipment	Fourth shipment	Fifth shipment
1 (over tandem wheels)	C	B	D	E	A
2	B	A	C	D	E
3	E	D	A	B	C
4	D	C	E	A	B
5 (rear of truck)	A	E	B	C	D

Description of Containers

All five of the containers were constructed from corrugated fiberboard, but there were considerable differences in their strength, size, shape, and construction. Details of their construction are presented in table 1 and fig. 1.

Cost of Containers

Container C was highest in cost, followed by containers E, B, D, and A (table 1). Container C, at 55 cents each, was the most expensive, and container A, at 25 cents for both box and liner, was the least expensive. The other three containers ranged from about 30 cents to about 48 cents each.

EVALUATION OF CONTAINERS, FILM, AND PRODUCT

At Processing Plant

At the processing plant, the turkeys were packed in the experimental containers as they came off the processing line, frozen in the containers, and held in storage at the plant until shipment. At the time of shipment, all

1/ The latin square experimental design was followed.

Table 1.--Specifications and costs of containers for 18- to 22-pound tom turkeys, 1959

Items	Type of containers				
	A	B	C	D	E
Style of container	1-piece folded corrugated fiberboard	Full-telescope, of corrugated fiberboard with die-cut holes in sides and ends	Full-telescope, of corrugated fiberboard with cutaway sides, and ends with supporting corner posts	Full-telescope, of corrugated fiberboard	Full-telescope, of corrugated fiberboard with cutaway sides and supporting corner posts
Liners, if any	250 test U-shaped liner around sides	None	None	None	None
Test, pounds per square inch	200	200 body 200 cover	275 body 200 cover	275 body 200 cover	275 body 200 cover
Tare weight	$2\frac{1}{4}$ lb.	4 lb.	4.2 lb.	4 lb.	3 lb.
Inside dimensions, inches	$17\frac{1}{2}$x15x9	20x15x$9\frac{1}{2}$	$19\frac{1}{2}$x$15\frac{1}{2}$x$8\frac{1}{2}$	18-3/4x17-3/4 x9	$21\frac{1}{4}$x13-3/4 x$9\frac{1}{2}$
Net weight of contents	36-44 lbs.	36-44 lbs.	36-44 lbs.	36-44 lbs.	36-44 lbs.
Number of birds per container	2	2	2	2	2
Method of assembling	Glued	Stapled	Stapled	Stapled	Stapled
Method of closing	Glued	By hand	By hand	By hand	By hand
Cost of container and materials per 1,000					
Containers	$206	$440	$550	$297	$478
Liners	43	---	---	---	---

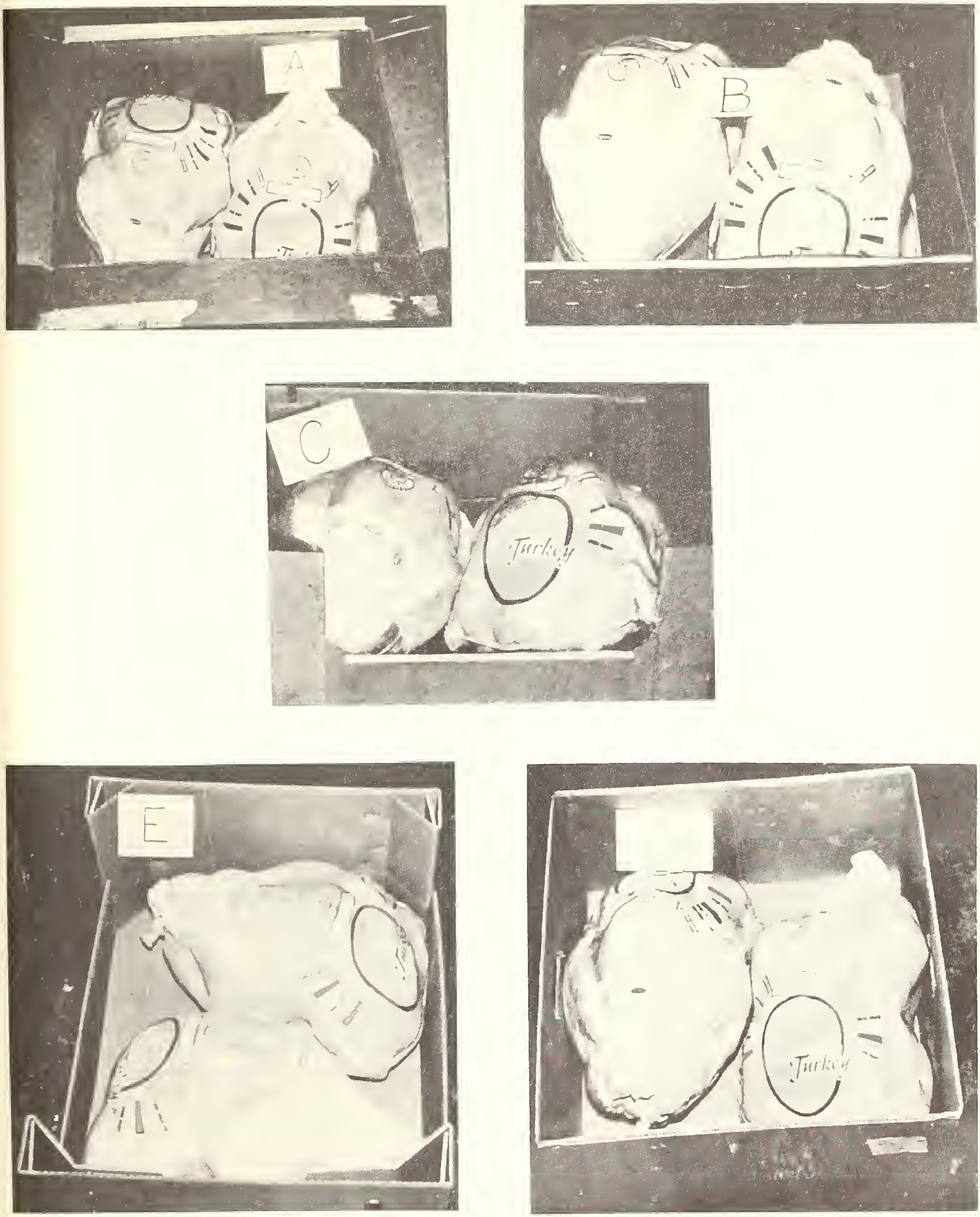


Figure 1.-- The five containers packed with tom turkeys for test shipments
Neg. A- BN 8022, B- BN 8030, C- BN 8021, D- BN 8028, and E- 8025

packs were inspected for condition of the containers, of the film bags in which the turkeys were packaged, and of the product. Of the more than 800 containers and 1,600 turkeys inspected, there was no container or product damage and there were only 37 minor film breaks.

The trailers in which the turkeys were transported were mechanically refrigerated. The thermostat on each trailer was set at 0° F. or below during the trip of nearly 3,000 miles from California to New York City. The truckers were those regularly used by the turkey processors, and the truck drivers followed their usual routes.

At Receiving Warehouse

As they were unloaded at the receiving end, the experimental boxes were inspected for damage to container, product, and film. Of the 821 experimental containers tested in the study, 240, or 29 percent, were damaged to some extent during the long haul from California to New York City. About 71 percent of the damaged containers showed slight damage and 29 percent moderate damage.

The types of damage were creasing along the sides, ends, and corners of the boxes, bulging at ends or sides, splits at corners, crushed ends, sides, or corners, concave tops (box tops depressed), and scuffing (scratched, scarred, or torn finish of the box). If a container sustained more than one type of damage, only the more serious damage was listed.

Concave tops accounted for about two-thirds of the number of boxes damaged. This condition seemed to result primarily from overhead weight, and occurred most frequently when the boxes were too deep for their contents, with excessive headroom between the top surface of the product and the top of the box.

Creasing accounted for about one-fourth of the number of boxes damaged. This type of damage also was usually caused by overhead weight and occurred for the most part among the one-piece folded single-wall containers and the full-telescope containers that were too deep for the product.

Crushing was evident on about 3 percent of the damaged boxes. The damage was slight, and usually was caused by overhead weight breaking down the box walls. Bulging accounted for only about 2 percent of the total number of boxes damaged. Split corners, accounting for only about 1 percent of the number of boxes damaged, usually were caused by failure of staples to hold or by tearing of the board at the box corners (table 2).

Table 2.--Type and degree of damage to shipping containers of turkeys, by type of container, at receiving warehouses

Types and degree of damage	Container identity					Total
	A	B	C	D	E	
	Number	Number	Number	Number	Number	
Creasing, slight	19	3	8	30	7	67
Bulging, slight	2	---	---	3	---	5
Split, slight	---	1	2	---	---	3
Crushed, slight	---	6	---	1	---	7
Concave tops	1	86	---	40	27	154
Slight	1	16	---	40	27	84
Moderate	---	70	---	---	---	70
Scuffing, slight	2	1	---	---	1	4
Total damage	24	97	10	74	35	240
Slight	24	27	10	74	35	170
Moderate	---	70	---	---	---	70
Total containers in experiment	138	147	182	178	176	821

Container Damage by Type of Container

Container C showed evidence of being the most effective of the five containers tested, from the standpoint of number of boxes showing the least in-transit damage, good appearance, and good product fit in the container. Of the 182 C-type boxes tested, only 10 showed recordable damage. This represented about 6 percent of the 182 C containers (table 2). The product fit well in the box. The pack was tight. Headroom measurements between the top surface of the product and the top of the box varied from less than $\frac{1}{4}$ to 3/4 inch, with more than 95 percent measuring $\frac{1}{2}$ inch or less (fig. 2).

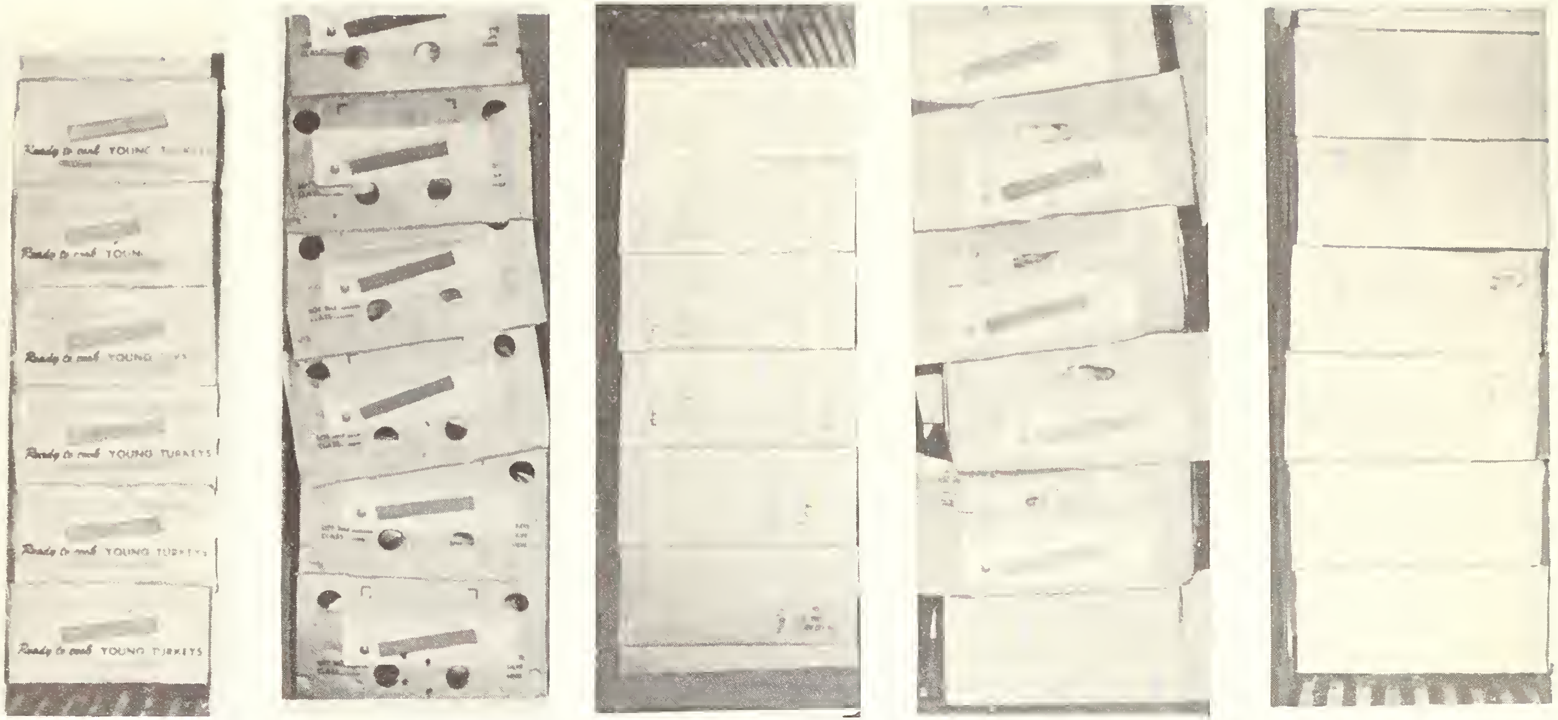
Container A was second lowest in incidence of container damage; 24 containers, or 17 percent of the 138 boxes tested, were damaged. All damage was slight; 19 of the 24 were creased, 2 bulged, 1 had a concave top, and 2 were scuffed on sides, ends, and tops (table 2). The product fit well in the container; all packs were tight, and headroom measurements varied from $\frac{1}{4}$ to 1 inch, 80 percent measuring $\frac{1}{2}$ inch or less (fig. 2).

Container E was at about the midpoint in damage. The number of containers damaged was 35, or about 20 percent of the 176 boxes tested. All damage was slight; 7 boxes were creased, 27 had concave tops, and 1 was scuffed (table 2). Although this container was of sturdy construction, it was too big in most instances for the 18- to 22-pound turkeys. This factor not only contributed to increased damage, but also used excess space in transit and in storage. The headroom in the box measured from 3/4 to $1\frac{1}{2}$ inches, and was $1\frac{1}{2}$ inches in about 75 percent of the containers (fig. 2).

Container D rated fourth, with 74 containers damaged, or about 42 percent of the 178 boxes tested. Concave tops were noted on 40 containers, creasing on 30, bulging on 3, and crushing on 1 (table 2). The pack varied from fairly tight to loose. Headroom varied from 3/4 to 2 inches; about 90 percent measured 1 inch or more (fig. 2). In width this container fit fair, in length it was too slack, and in depth it was too deep for the turkeys.

Container B held up the least well. There were 147 B-type containers in the experiment, and 97 of them, or about 66 percent, were damaged; 86 had concave tops, 70 of which were moderately damaged and 16 slightly damaged; 6 others were crushed slightly, 3 slightly creased, 1 slightly bulged, and 1 slightly scuffed (table 2). The turkeys did not fit the container well, the pack was loose, and the container was generally too large for its contents. There were from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches of excess space between the top surface of the turkeys and the tops of the boxes. In about two-thirds of the containers, the slack measured 2 inches or more (fig. 2).

Containers B, D, and E, which had a high incidence of concave tops, all were too large for the 18- to 22-pound turkeys they carried. With heavier turkeys in a tight pack, these same containers might well have turned in a good performance. Turkeys weighing more than 22 pounds were not included in this test because they represent a relatively small part of the total of turkeys marketed.



BN 8027 Container A | BN 8026 Container B | BN 8023 Container C | BN 8029 Container D | BN 8024 Container E

Figure 2.--Stacks of five different containers in truck at Eastern terminal after cross-country haul. Containers C and A sustained the least damage and containers B and D the most damage.

Statistical analysis of the observations on damage showed that differences among the containers were highly significant. The probability that observed differences between containers were due to chance was less than 1 in 100.

Container Damage by Position in Load and Type of Container

As already noted, the experimental containers were loaded in five stacks numbered from the tandem wheel area to the rear of the truck, stack No. 1 being nearest the tandem wheels and stack No. 5 nearest the rear of the truck.

The greatest number of A containers were damaged in stack 5, followed by stacks 4, 1, and 2, and there was no damage in stack 3. The highest number of B containers damaged were in stack 4, followed by stacks 5, 1, and 2, with the smallest number in stack 3. For container C, the most damage occurred in stack 4 followed by stack 5, with no damage recorded for stacks 1, 2, and 3. Container D was damaged most in stack 3, followed by stacks 5, 2, 1, and 4. Container E had the highest incidence of damage in stack 4, followed by stacks 1 and 5, both of which had the same number of containers damaged, and stacks 3 and 2 (table 3).

Truckers and receivers reported that the highest incidence of damage usually is found among containers stacked in the rear of the trailer, and the next highest damage rate occurs among containers stacked directly over the tandem wheels. Although more damaged test containers were observed in the two rear stacks than farther forward, the differences were not statistically significant.

Container Damage by Layer and Type of Container

To determine damage to product, film, and container by layers, samples of containers were randomly selected for inspection while the trucks were being unloaded. One container was selected from each of the 8 layers in each tier for each of the 5 containers. The sample consisted of 40 boxes and 80 turkeys for each type. Layers were numbered from the floor of the truck upwards so that No. 1 was on the floor and No. 8 on top of the load. The greatest number of damaged containers of all types occurred in layers 1 through 6. Damage was least frequent in layers 7 and 8. Within the bottom 6 layers, the highest incidence of damage was in layer 2 and the lowest in layer 5 (table 4).

Differences in damage among layers, regardless of container type, were statistically significant. 2/ The main difference was between the top two layers and the six lower layers.

2/ At the 90 percent level.

Table 3.--Damage to containers of turkeys by type of container and position in load, at destination, 18- to 22-pound tom turkeys

Position in load	Containers									
	A		B		C		D		E	
	Number	Pct. of total	Number	Pct. of total	Number	Pct. of total	Number	Pct. of total	Number	Pct. of total
Stack										
1.......	5	20.8	23	23.7	---	---	10	13.5	8	22.9
2.......	3	12.5	11	11.3	---	---	13	17.5	3	8.5
3.......	---	---	10	10.3	---	---	28	37.9	5	14.3
4.......	6	25.0	29	29.9	6	60.0	6	8.1	11	31.4
5.......	10	41.7	24	24.8	4	40.0	17	23.0	8	22.9
Total...	24	100.0	97	100.0	10	100.0	74	100.0	35	100.0

Table 4.--Number of containers damaged in a randomly selected sample inspected at the receiving warehouses, by layer and type of container, 18- to 22-pound tom turkeys

Layer number	Containers damaged, by type					Total damage, all containers	Total containers inspected
	A	B	C	D	E		
	Number	Number	Number	Number	Number	Number	Number
1 (Floor)	1	5	---	4	3	13	25
2	2	5	1	4	5	17	25
3	3	4	---	3	4	14	25
4	4	4	1	4	2	15	25
5	2	2	1	3	3	11	25
6	2	5	1	4	3	15	25
7	2	1	---	3	---	6	25
8	1	2	---	1	1	5	25
Total containers damaged	17	28	4	26	21	96	---
Total containers inspected	40	40	40	40	40	---	200

Rated on the basis of the smallest number of containers damaged, container C ranked first, followed by containers A, E, D, and B. The containers tended to maintain this same relative rank within the layers as in the load as a whole.

Film Damage

Film damage was minor, both in number of film breakdowns and in degree of damage. Eighty turkeys were inspected for film and product damage for each type of container. Of the 400 turkeys examined, less than 10 percent showed any film damage. The most common types of damage were film breaks in the hock area and in the breast and thigh areas, and abrasions on the breast and thigh areas. Most of the film breaks were caused by air bubbles which resulted from failure to attain an adequate removal of air from the pack, according to the processor.

Product Damage

There was no evident product damage among the 400 birds examined. All turkeys were of good color and there was no evidence of dehydration in the areas of film breakdown.

OUTSTANDING ADVANTAGES AND DISADVANTAGES, BY TYPE OF CONTAINER

Some of the advantages and disadvantages of the containers, as described by processors, warehousemen, and handlers, were:

Container A.--The appearance was good. This box was easy to handle, tied in securely in pallet loads, stacked well to efficient heights, and received the most favorable comments from workmen and warehousemen. They all liked its looks and said that it held up well in storage. The processor liked it for its efficient shape and its low unit cost, and because the product fit it well; it was sturdy enough to protect the product adequately, and it was easy to assemble, pack, and close. Another advantage of this container is that it can be closed automatically by a case sealer. The main disadvantage mentioned was that the flaps were glued and the box was difficult to open and close again.

Container B.--This container had only a fair appearance because, during transit, many of the containers became distorted in shape. The only favorable comment from the processor was that it was good for freezing in the box. The processor said it was difficult to set up and he felt that the ventilation holes reduced the strength of the box. The container received no favorable comment at the warehouse level except that the workmen thought it easy to get a handhold because the vents in the ends were good for fingerholes. The warehousemen said that the vents would allow too much warm air to flow in on the product while it was being moved.

Container C.--This container had the freshest appearance after the coast-to-coast haul. It was easy to open and to close. The processor reported that its cut-down sides and ends facilitated packing and freezing in the box; and that the turkeys fitted it well but makeup cost was too high. The warehousemen commented that the heavy board and corner posts gave it superior packing strength and that the shape was good for stacking stability and tying into palletloads. The box was considered expensive and possibly stronger than necessary.

Container D.--This container was rated only fairly good in appearance. The processor thought that the box provided a very poor fit for the product. He made no other unfavorable comments and no favorable comments. The warehousemen's only comment was that the excess headroom would probably make the container deficient in stacking strength. The workmen felt that it was easy to handle.

Container E.--In appearance, this container rated good. The cutaway sides facilitated freezing in the box. The warehousemen felt that it was too square to tie in on pallets or to form a stable stack. Its strength was adequate. The processor reported the container difficult to assemble and said it did not provide a good fit for the turkeys.

CONCLUSIONS

Structural strength and the ability to provide a good fit for the contents appeared to be outstanding factors in the reduction of container damage. Containers with the lowest incidence of damage were constructed with supporting corner posts or liners and carried snug packs which had no room to move about during transit and handling.

Container cost is important to the processor. The container receiving the least damage cost the most, while the container with the next lowest incidence of damage cost the least. For 800 containers--an average load--the difference in cost between the most expensive and the least expensive container would be $240. This amounts to 3/4 of a cent per pound of processed turkey. Although the most expensive container resisted scuffing and creasing better than the least expensive container, they protected their contents equally well, and the least expensive container received the most favorable comments from the receivers.

The good condition in which the turkeys arrived at the receiving end could be attributed not only to the protection given the product by the containers but to the skill and care used in processing, packaging, freezing, and loading the turkeys for shipment. The turkey processor originating the experimental shipments places high value on skilled workmanship and product quality.

Good treatment of the container at the receiving end when unloading and storing is important in curtailing container damage and in maintaining high quality in the product. In most instances, the containers were handled with skill and care while they were being unloaded and palletized for storage. However, there was one instance in which very crude methods were employed--one workman dropped boxes of frozen turkeys from the top of the stack to the floor of the truck, another workman picked them up from the truck floor and dropped them to the street level. As a result, containers that were in excellent condition on arrival at the receiving end were badly damaged. In a few instances the turkeys popped out of the containers. Such treatment more than offsets all that is gained in processing, packaging, and delivering a quality product to the receiver.

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