# Protecting Shell Eggs Between Packing Plant and Supermarket

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Studies the importance of factors affecting eggshell damage such as type of pack, age of laying hen and season of year.

Some of the major factors influencing shell egg quality during distribution are the age of the laying hen, climatic conditions, handling methods, and packaging materials.

The objectives of this study were: 1. determine the rate of eggshell damage along the distribution channel by age of laying hen, season of year, and type of pack (refers to the combination of master container type and stacking pattern of egg cartons within the container).

2. To determine whether eggs which had checked shells when sampled at the packing plant have a greater tendency to become leakers by the time they reach the supermarket than do eggs which have sound shells at the plant.

## Procedures

Research was conducted over a one year period in three States: Alabama, Minnesota, and Texas. Cooperation in these States was obtained from five large packing plants and 16 retail supermarkets of various sizes. Outdoor temperatures ranged from -30°F to 102°F.

The two types of master containers tested were:

1. Corrugated paperboard case, 30-dozen capacity, 200-pound bursting strength.

2. Wire basket, 15-dozen capacity.

The stacking pattern of the egg cartons within the master containers was either parallel or cross tiered. Both stacking patterns were used in each type of master container.

The eggs in each test shipment were grade A or AA large and came from birds that were from 36 to 70 weeks old. The eggs were kept at temperatures ranging from 55° to 75°F, with 80 percent relative humidity, and were 1-2 days old when they were packed and graded at the plant.

Several types of egg cartons were used, but only one type was used for each individual truck shipment from plant to supermarket. In addition, all eggs for each shipment came from the same flock of birds.

1. Within five paperboard cases, alternate tiers of egg cartons were stacked parallel with each other. The bottom tier of cartons was placed either across or along the seam formed by the meeting of the bottom inner case flaps.

2. Within the remaining five paperboard cases, alternate tiers of cartons were cross stacked. Again, the bottom tier of cartons was placed either across or along the seam.

3. Within five wire baskets, alternate tiers of cartons were stacked parallel with each other.

4. Within the remaining five baskets, alternate tiers of cartons were cross stacked.

At each checkpoint, graders inspected the eggs according to the standard U.S. Department of Agriculture random sampling procedures.

Examination was for checks and leakers only. The data presented here are based on a total of 24 truck shipments of 20 master containers each. Most shipments were delivered on straight body trucks for short hauls or on tractor trailers for long hauls. The one-way distance between packing plant and supermarket ranged from 105 to 330 miles. The transport vehicles were all fully loaded and the test containers were randomly handstacked (unpalletized) at the rear of the vehicles where the ride was the roughest. Driver competence varied as did the suspension of the vehicles and road conditions.

It is pointed out most strongly that, although handling methods differed from plant to plant and from supermarket to supermarket, each master container of eggs within each individual shipment was handled the same as every other container in that particular shipment to keep the chances of damage to any one of them equal.

After grading at the plant, the master containers were placed on pallets and moved to the cooler. Each pallet held 20 containers--10 cases and 10 baskets. Half of the cases and half of the baskets were cross packed, and the remaining half were parallel packed. These 20 master containers would make up one shipment. After storage in the cooler from 8 hours to 4 days, a pallet of eggs would be transported to the loading dock and handstacked randomly at the rear of the delivery vehicle. This process was repeated for all shipments.

At the retail store, the eggs were unloaded at either street level or dock height. Most shipments were unloaded by 2- or 4-wheel handtrucks, and several shipments were unloaded by conveyor belt. The containers of eggs were moved to the grading area of the supermarket and inspected.

After information on egg shell damage was collected, data were subjected to analysis of variance and Duncan's multiple range test to separate means. Statistical significance was at the five percent level of probability.

## Inspection Results

Although the following tables show the rate of eggshell damage at the packing plants and supermarkets, only the latter is being considered here. The damage at the plant is shown only to reflect the starting base upon which additional damage within the distribution network was added.

Table 1 shows the mean rate of eggshell damage by age of laying hen. The percentage of checked eggs at the supermarket was significantly lower for eggs which come from birds under 40 weeks old (0.29 percent) than for eggs which came from birds from 40-60 weeks old (1.7 percent) and over 60 weeks old (2.02 percent). There was no significant difference in the rate of leakers between age groups.

Table 2 shows the mean rate of eggshell damage by season of the year. The rate of checks and leakers was significantly lower for eggs that were produced and shipped in the winter (0.79 percent and 0.05 percent respectively) than for eggs that were produced and shipped

Table 1. Mean rate of eggshell damage by age of laying hen

| Age (weeks) | Inspection Station: Packing Plant Checks | Packing Plant Leakers | Supermarket Checks | Supermarket Leakers | Total Checks | Total Leakers |
|---|---|---|---|---|---|---|
| | Percent | Percent | Percent | Percent | Percent | Percent |
| Under 40 | 0.85 | 0.10 | 0.29 | 0 | 1.14 | 0.10 |
| 40 - 60 | 2.81 | .21 | 1.70 | .15 | 4.51 | .36 |
| Over 60 | 2.78 | .50 | 2.02 | .18 | 4.80 | .68 |

Table 2. Mean rate of eggshell damage by season of year

| Season | Inspection Station: Packing Plant Checks | Packing Plant Leakers | Supermarket Checks | Supermarket Leakers | Total Checks | Total Leakers |
|---|---|---|---|---|---|---|
| | Percent | Percent | Percent | Percent | Percent | Percent |
| Summer | 3.25 | 0.33 | 2.20 | 0.15 | 5.45 | 0.48 |
| Spring-Fall | 2.71 | .19 | 1.44 | .26 | 4.15 | .45 |
| Winter | 1.59 | .12 | .79 | .05 | 2.38 | .17 |

during any other season of the year. Eggs produced and shipped in the spring and fall had a significantly lower rate of checks (1.44 percent) than did eggs produced and shipped in summer (2.20 percent). The difference in leakers between spring-fall and summer was insignificant.

Table 3 shows the mean rate of eggshell damage by two types of master containers and two stacking patterns within each (pack). There were significantly less checks to eggs which were cross stacked in cases (1.28 percent) than those that were parallel stacked in cases (1.68 percent). There was no significant difference in the rate of leakers, regardless of pack.

Because damage is greater during the warm months of the year than during the cool months, Table 4, is shown to reflect the rate of this damage based on the same criteria as Table 3, except that Table 4 reflects damage only during the summer. Note that the damage rates were greater in the summer months, yet almost the same relationship of damage rates between the four packs was maintained with one exception. There was a significant difference not only between checked eggs which were cross stacked in cases (1.57 percent) and checked eggs which were parallel stacked in cases (2.52 percent), but also between checked eggs that were cross stacked in cases and those in both basket patterns; i.e., shell eggs packed cross tiered in cases had a clearly lower rate of damage than eggs in the other three packs.

The final objective of this study was to compare the probability that checked eggs at the plant would become leakers during handling and distribution to the supermarket with the probability that sound eggs at the plant would become

Table 3. Mean rate of eggshell damage by two types of master containers and two stacking patterns within each pack

| | Inspection Station | | | | | |
|---|---|---|---|---|---|---|
| | Packing Plant | | Supermarket | | Total | |
| Pack | Checks | Leakers | Checks | Leakers | Checks | Leakers |
| | Percent | Percent | Percent | Percent | Percent | Percent |
| Basket: | | | | | | |
| Parallel | 2.37 | 0.19 | 1.39 | 0.07 | 3.76 | 0.26 |
| Crossed | 2.75 | .29 | 1.58 | .14 | 4.33 | .43 |
| Case: | | | | | | |
| Parallel | 2.37 | .23 | 1.68 | .15 | 4.05 | .38 |
| Crossed | 2.38 | .17 | 1.28 | .13 | 3.66 | .30 |

Table 4. Mean rate of eggshell damage between packing plant and retail store during the summer months, by type of pack

| | Inspection Station | | | | | |
|---|---|---|---|---|---|---|
| | Packing Plant | | Supermarket | | Total | |
| Pack | Checks | Leakers | Checks | Leakers | Checks | Leakers |
| | Percent | Percent | Percent | Percent | Percent | Percent |
| Basket: | | | | | | |
| Parallel | 3.23 | 0.27 | 2.28 | 0.13 | 5.51 | 0.40 |
| Cross | 3.21 | .48 | 2.41 | .29 | 5.62 | .77 |
| Case: | | | | | | |
| Parallel | 3.26 | .32 | 2.52 | .10 | 5.78 | .42 |
| Cross | 3.32 | .24 | 1.57 | .08 | 4.89 | .32 |

Table 5. Sound-shell eggs and checked-shell eggs that became leakers between packing plant and supermarket

| | Packing Plant | | Supermarket Leakers | |
|---|---|---|---|---|
| Shell Condition | Number | Percent | Number | Percent |
| Sound | 47,040 | 98 | 69 | 77.5 |
| Checked | 960 | 2 | 20 | 22.5 |
| Total or Average | 48,000 | 100 | 89 | 100.0 |

leakers during those procedures. Table 5 shows that the 2 percent of checks at the plant amounted to 22.5 percent of the leakers at the supermarket. Therefore, checked eggs at the plant were more than 10 times likely to become leakers than sound eggs.

## Conclusions and Recommendations

This study indicated that packing materials and stacking patterns become more critical to damage rates as the age of birds increase and as climatic temperature rises. Eggshells have higher damage rates at both the packing plant and the supermarket when the above conditions are present. A clear difference in damage rates exists, depending on the stacking pattern of egg cartons in their respective master containers.

When cartons are cross stacked in paperboard cases in warm or hot weather, checks are 38 percent lower than when parallel stacked in cases, 35 percent lower than when cross stacked in baskets, and 31 percent lower than when parallel stacked in baskets.

Therefore, as the propensity for damage increases, the protection afforded by cross stacking in paperboard cases also increases to a significant extent.

The lower rate of damage to eggs which are cross stacked in cases may not be significant enough for users of baskets to switch to cases. This is a judgment which can only be made by the users themselves based on their individual requirements. It is strongly recommended, however, that packing plants and supermarkets presently handling shell eggs in cases ensure that those eggs are cross stacked because of the significantly lower rate of damage which prevails.

Another result of this study reflects the high rate of leakers that develop among eggs that were initially checked at the packing plant. Although the total rate of leakers at the supermarket checkpoints was low, the losses generated by those leakers are often quite high. Examples of this can be found in a 30-carton master case which may have only 2 or 3 leakers near the top of the case. These leakers are not only capable of making other eggs in their respective cartons undesirable from their exuding contents, but very often manage to drip onto 10 or 15 other cartons underneath. In many instances, those cartons which are damaged on the outside by the leakers are considered a loss by the retail store and are returned to the packer for credit.

The rates of checks and leakers discussed here have been small. However, when the differences in damage rates are projected over the entire shell egg industry, they add up to an appreciable amount. Therefore, to keep damage to a minimum, the most efficient stacking pattern should be used. Also, keeping checked eggs which leave the packing plant to a minimum will significantly reduce the rate of leakers which appear at the supermarket.