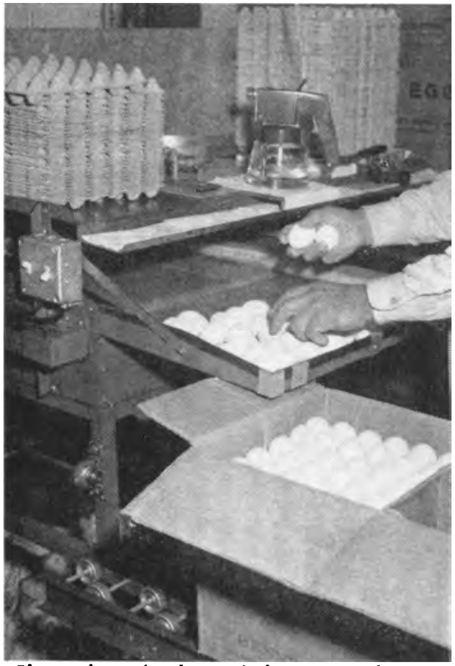


Photo above (and cover) shows egg placement into containers preparatory to cooling-rate tests in refrigeration rooms.

EGG COOLING RATES affected by containers

D. D. BELL · R. G. CURLEY

Rapid cooling is one of the most important factors in maintaining initial egg quality. Tests conducted on a poultry ranch in southern California show that the time required for cooling eggs is greatly affected by the container in which they are packed. Best cooling conditions are obtained when the egg has the least packaging or a container that permits maximum exposure to the cooling air. Packages which reduce exposure to the air or insulate the egg increase the cooling time.

IT HAS BEEN RECOGNIZED that interior egg quality declines with longer storage time and higher temperatures. This loss in quality appears primarily in the deterioration of the albumen and yolk causing them to weaken and flatten. Time and temperature also hasten the evaporation of moisture from the egg, resulting in an enlarged air cell. An enlarged air cell is one of the factors used by candlers to indicate lowered egg quality. Previous research has shown that yolk and albumen will retain quality if the eggs go into cooling within two or three hours after they are laid, and are air cooled to 60°F or lower within eight or ten hours. This time and temperature relationship is understood by producers, handlers, and retailers. All three groups use refrigeration and rapid handling procedures in their egg marketing programs. Providing high quality eggs to the consumer necessitates starting out with high quality eggs and maintaining this quality by proper handling methods.

Until recently, most California producers performed all of the processing chores prior to the retail level except candling and cartoning. The eggs were gathered, cleaned (usually by washing), sized, cooled, and cased at the ranch. Casing sometimes preceded cooling, which resulted in slower cooling rates. The eggs were usually picked up by the processor two or three times weekly and taken to a central plant for grading and cartoning.

With the introduction of large capacity washers, sizing equipment, and automatic cartoners, eggs are now picked up daily from the ranch. They are processed and cartoned the same day or the following day and placed into retail channels almost immediately.

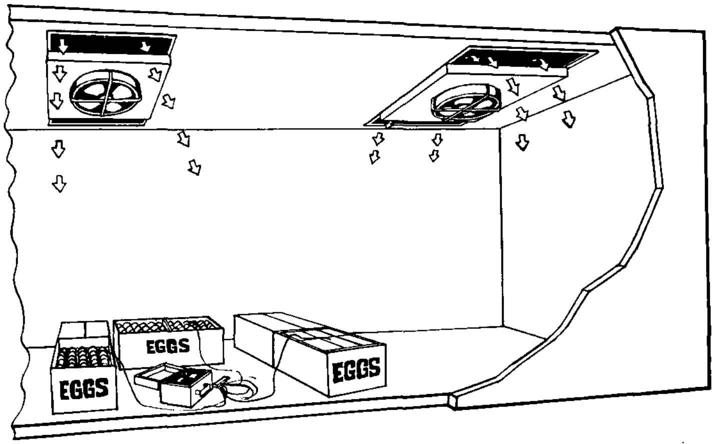
It is possible, under this new method of handling, for warm, freshly laid eggs (about 105°F when laid) to be gathered and shipped to a processor in a very short time. At the processor's, these warm eggs may be washed immediately (at water temperatures above 100°F) which can raise the internal egg temperature by another 5°F. The eggs are immediately graded, cartoned, cased, and placed in a refrigerated holding room. Under these procedures, many eggs are not cooled quickly and quality is lowered. Only the producer and handler can create conditions favorable for rapid cooling to minimize this deterioration. It was the purpose of this test to determine what effect the packing container had on the time required to cool eggs under typical holding conditions.

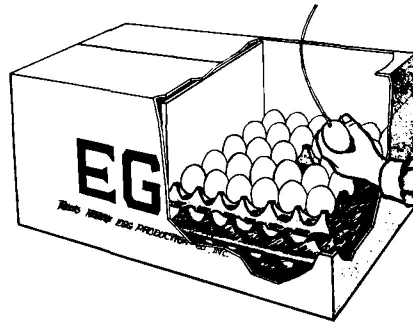
The egg cooling studies were conducted on a commercial egg ranch in Orange County with an egg processing room and refrigerated storage room available. All eggs in the study were produced, washed, and sized the day before use in the tests. Only large eggs were used in the tests. The eggs were cased following washing and sizing and were left in the uncooled egg room overnight until the next morning. Fifteen dozen eggs were removed from the cases and placed in wire baskets. The baskets were then immersed in 110°F water for 10 minutes to bring the internal temperature of the egg to between 90°F and 100°F.

The eggs were then run through a single-line, revolving brush-type cleaner without water to dry them (except as noted) and packed in the following types of containers for the cooling tests: molded pulp filler flats; plastic filler flats (two types); one dozen cartons (2×6's) of both molded pulp types and molded chipboard types. These primary containers were then placed in secondary containers including both fiber cases (open and closed); and wood cases. Both wet and dry eggs were cooled in plastic filler flats.

For temperature measurements, the center egg of the third layer (six layers total) from the bottom of each 15-dozen-stack was removed (see sketch). A small hole was punched in the large end of this egg and the temperature-sensing tip of a thermocouple was positioned in the center of the egg. The opening was sealed and the egg was replaced in the stack. The stacks were taken to a refrigerated holding room where temperatures were recorded as cooling progressed. At least three replicates were used in each packing situation. Additional tests were made when excessive variation resulted. Egg cases were placed one case high in the center of the refrigerated room as seen in sketch and photo. The egg room was maintained at a temperature of 55° F plus or minus 4° F. The humidity was held at 78% plus or minus 12%. The room was 9 ft wide by 19 ft long by 6 ft 8 inches high. Refrigeration was supplied by two ceiling units located 3½ ft from each end. A 14-inch fan on each cooling unit provided air circulation by forcing the air outward toward the side walls.

Forced air cooling rates for perforated





Egg with thermocouple wire for temperature measurement was placed near center of each case during the test procedure.

Sketch above, left, shows overall layout of cold room with ventilation as used in test in photo below showing egg cases and instrumentation for accurate temperature measurement.

cases were investigated in four tests. Both sides of each case in these tests were perforated in one of the following three patterns: twelve ¾-inch diameter holes; one ½-by-1½-inch vertical slot; or two 2½-inch holes, one above the other. An ordinary household fan located 24 inches from the stack of perforated cases provided an air velocity of 1160 ft per minute at 4 inches in front of the fan. A cardboard tunnel 24 × 26 inches × 2 ft in length conducted the air to the cases. The eggs were packed in molded pulp filler flats within the cases.

In analyzing the data, container combinations were reduced to eight categories, placed in turn in four groups, each representing a range of cooling times. The spread in cooling times within a given range was obtained by repeating the tests. Variations found were thought to be caused by nonuniform air movement within the room. Results are shown in the graph and below:

Group	Method of packing	Cooling* time (hrs.)
A	Fiber filler flats in fiber cases with forced air cooling through openings in cases	2–5
B	Plastic and fiber filler flats, open stack	5–10
C	Formed and folded cartons, open stack	15–25
	Formed and folded cartons, wood case	
	Plastic and fiber filler flats, wood case	
	Plastic and fiber filler flats, fiber case, open	
D	Plastic and fiber filler flats, fiber case, closed	30+
	Formed and folded cartons, fiber case, closed	

* Time required to cool from 90° F to 60° F

The use of forced air on eggs packed in filler flats and placed in closed fiber cases with perforated sides reduced cooling time to approximately one-eighth that of conventional cooling in closed fiber cases.

The primary factor affecting rate of cooling is the degree of exposure of the egg to air in the cold room. This degree of exposure is directly related to (1) the "openness" of the container and (2) air circulation. In a conventional cold room without a forced air cooling system, the eggs must be placed in open containers such as stacked filler flats if the cooling time (to 60° F) is to fall within the recommended 8 to 10 hour limit. Placement of eggs in tight containers such as the closed fiber cases will result in excessively long cooling periods even where the cases are not stacked.

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