CANDLING ERRORS (OVERPULL) IN CALIFORNIA SHELL-EGG PROCESSING PLANTS

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Primary Audience: Egg Processing Plant Managers, Extension Specialists, Researchers, Egg Inspectors

SUMMARY

Rejecting good eggs by placing them as undergrades (overpull) is a common error among candlers, costing egg processing plants in the U.S. millions of dollars annually. This study of twelve egg cartoning plants in California evaluated overpull problems and searched for possible reasons for candling errors which lead to overpull. It revealed that at a machine speed of up to 240 cases/hr, egg candlers were pulling 82.7% eggs correctly as undergrades; however, 17.3% which they pulled as undergrades were good eggs without any detectable defects. Among those eggs labeled "undergrades," most of the common defects were cracked eggs (70.7%), dirties (6.2%), shell defects (3%), stains (1.3%), B Grade eggs (1.3%), and blood spots (0.2%). The most common reason for overpull was wire marks (42.5%), other reasons included minor shell deformities (11.9%), body checks (11.7%), floating air cells (3.2%), and unknown reasons (30.6%). The literature suggests that false identification of defects can be reduced by extensive training of egg candlers. However, when using higher speed packing equipment, automatic detection devices or additional candlers will be required to perform the basic function of reject detection and to minimize the amount of overpull.

Key words: Egg candling, overpull, shell-egg processing
1995 J. Appl. Poultry Res 4:100–104

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DESCRIPTION OF PROBLEM

Egg candling is the focal point of monitoring egg quality at commercial shell-egg processing plants because egg candlers are responsible for removing eggs with defects and assuring that the cartoned eggs meet regulatory and company standards. Experienced candlers can achieve remarkable accuracy while evaluating several quality components. However, a common candling error is the rejection of good eggs as undergrades [1, 2]. This error often goes unnoticed because state or local graders do not routinely reinspect undergrades. Overpull can affect plant profitability as a result of reduced egg value, but this problem can be partially remedied by proper training of egg candlers [1, 2].

At a machine speed of 240 cases/hr with two candlers, each candler must observe a dozen eggs/sec. The modern grading machine has reduced the work load of the candler by automating the removal of defective eggs. With older equipment, the candler had to physically remove each rejected egg. Newer machines require only touching the egg with an identification instrument. The machine then recognizes which egg to remove later in the process. This system has greatly improved the candler's ability to remove higher numbers of reject eggs.

However, it still does not allow time for indecision. Thus, candlers still make errors by either pulling too many good eggs as undergrades (overpulling) or not pulling all defective eggs (underpulling). Obviously, underpulling causes eggs to be rejected by inspectors. As a result, this type of error usually results in rapid negative feedback from plant management to the candler. The criticism can cause candlers to reject any egg which is "questionable," leading to excessive overpull. Overpull often exceeds 30% of the rejected eggs. To reduce overpulling, many egg processors are using pre-candlers who reduce the candler's workload by removing obvious undergrades before the eggs reach the candler booth.

Because of these situations, this study attempted to determine the extent of overpull occurring in California shell-egg plants, to bring this loss to the attention of plant management, to encourage them to improve training of candlers, and to initiate quality control procedures which will minimize overpull.

MATERIALS AND METHODS

Twelve California table-egg processing plants with equipment capable of packaging at least 240 cases/hr were evaluated during December, 1991 and January, 1992. Two cases of eggs (720 eggs) per plant from the off-grade rack were set aside without the candler's knowledge. Then University of California Cooperative Extension (UCCE) personnel hand candled the 720 egg sample. The UCCE person working with the processing plant quality control supervisor first separated cracked eggs from the sample and counted them and then classified the remainder of the eggs as either "undergrade" or "overpull" as follows:

A. Undergrades
   1. Cracks and leakers (combined)
   2. Stains
   3. Dirty (adhering material)
   4. Abnormal shells (very misshapen, pronounced ridges or roughness, weak spots)
   5. "B"s (yolks plainly visible, air cell greater than 3/16 inch)
   6. Bloods

B. Overpull
   1. Wire marks or windows
   2. Healed body checks
   3. Floating or bubbly air cells
   4. Minor shell shape or roughness
   5. No known reason

RESULTS AND DISCUSSION

An average of 17.3% of the rejected eggs were incorrectly removed by candlers in the twelve plants studied (Figure 1). This overpull ranged from less that 2% to nearly 48% in individual plants. Plants in northern and southern California had similar average rates of overpull (17.1% and 17.5%, respectively).

The types of undergrade eggs found in this study appear in Table 1. As expected, cracked and broken eggs were the predominant type of undergrade (70.7%); incorrectly pulled good eggs were the second most common type (17.3%); followed by dirties (6.2%), shell defects (3.0%), stains (1.3%), true "B" grades (1.3%), and blood spots (0.2%).

All incorrectly pulled eggs were examined to determine the most probable cause for re-

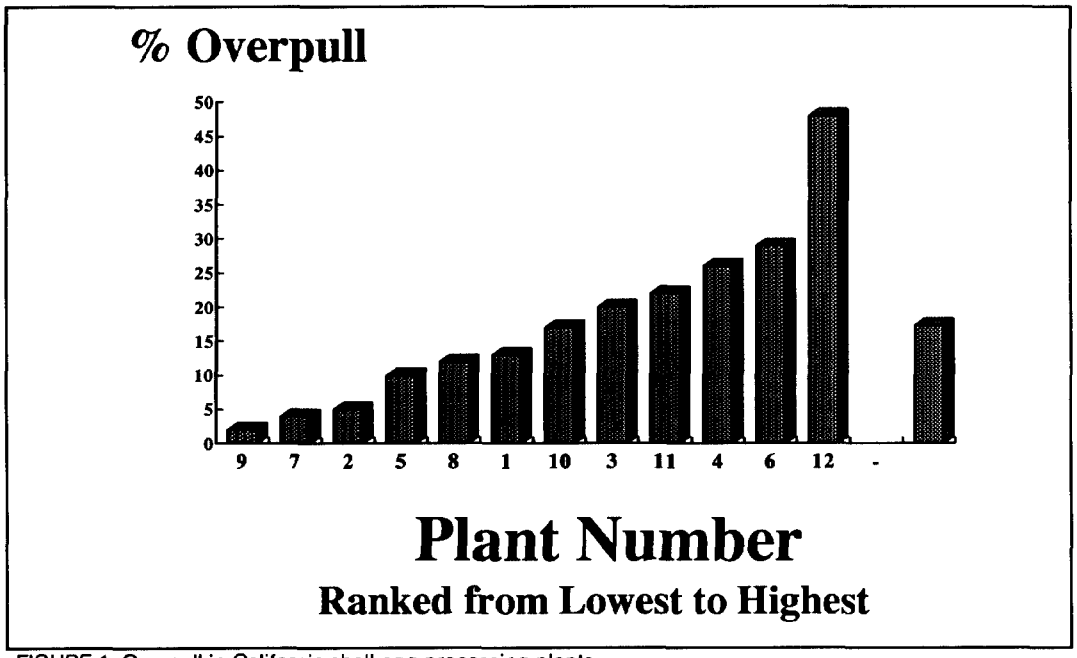

FIGURE 1. Overpull in California shell-egg processing plants

TABLE 1. Types of rejected eggs

CATEGORY	REJECTS (%)
Cracks	70.7
Stains	1.3
Dirties	6.2
Shell defects	3.0
"B" grades	1.3
Blood spots	0.2
Sub-total	82.7
Good eggs	17.3
Total	100.00

jection by the candler. Figure 2 shows that wire marks (sometimes called windows) were the most common probable cause for egg rejection. False cracks like wire marks are often mistaken for cracks [3, 4]. No reason could be determined for rejection of 30.6% of the eggs. Other apparent reasons for rejection were body checks (11.7%), misshapen shells (11.9%), and air cell defects (3.3%).

Overpull has a profound effect on plant revenue. Assuming a 5% undergrade rate, the 17.3% average overpull found in this study would translate to the downgrading of forty-three cases out of every 5,000 cases processed. Estimated losses due to overpull ranged from $28 to $898 per 5,000 cases processed for the twelve plants sampled (Table 2). If the associated loss in egg value is $0.25/doz, the average loss would be $324 per 5,000 cases processed. For the average egg processing plant in the 1992 study [5] which processed 12,195 cases/wk an estimated annual loss of $41,902 would occur. For the 355,000 cases/week of the California egg industry, losses would reach an estimated $1 million in 1994.

There are several factors which affect candling errors. These include machine speed, incidence of undergrades, age of eggs, candler training, candler attitude, and effective supervision of candler underpull and overpull [1, 2, 3, 4, 6]. While the number of plants surveyed in this study is too small for a valid statistical comparison of factors contributing to differences in overpull, the plants with low overpull were generally processing at slower speeds, often 160–180 cases/hr. This rate is certainly far below the actual capability of their equipment. Pre-candlers who pull obvious undergrades such as cracks and dirties also tended to contribute to low overpulls. However, any decrease in processing machine speed or additional labor will be associated with increased cost.

It seems obvious that as the output of packaging machines increases to 400–500

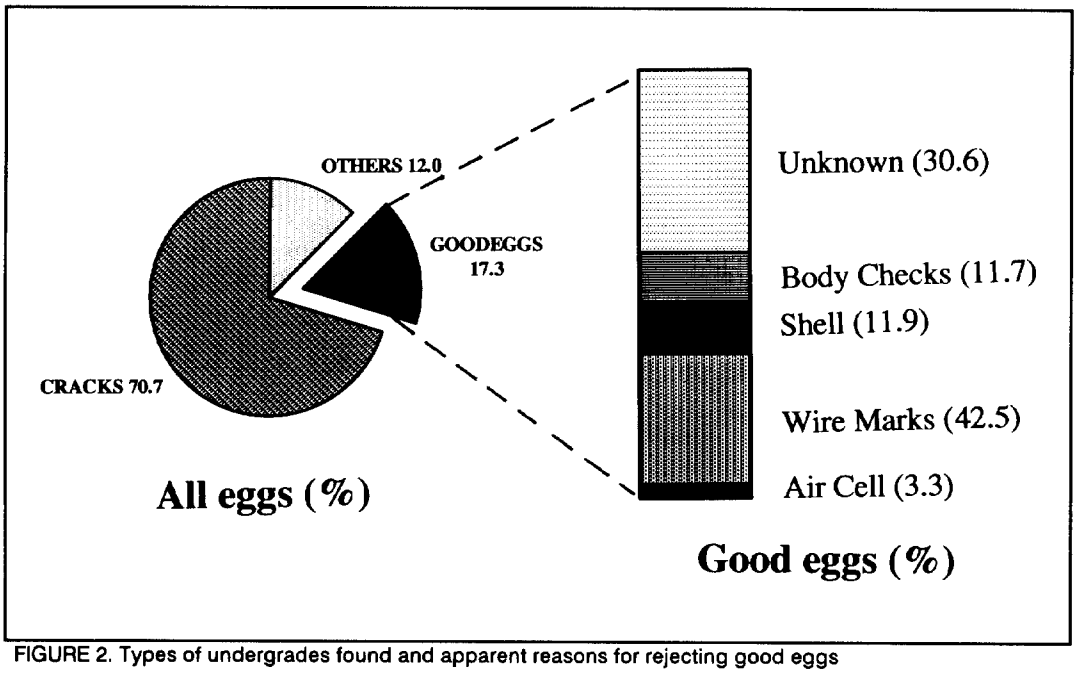

FIGURE 2. Types of undergrades found and apparent reasons for rejecting good eggs

cases/hr, the candler's ability to provide accurate performance for a long period of time is approaching the limit of human ability. Equipment of this capacity will require either additional candlers, automatic detection devices, or a combination of both. Reducing overpull alone could hardly be justification for purchasing the newly available automatic devices for existing equipment. Consideration of this investment should be associated with purchasing new, higher speed machines. For existing equipment it was demonstrated by Strong and Wilson [1, 2] that a training program which includes one-on-one instruction could reduce candler errors by up to 30%. However, one must remember that the more sophisticated the equipment, the more adequate training the candler will need.

TABLE 2. Variation and costs of grading errors

PLANT NO.	ERROR (%)	ERRORS/5000 CASES	COST/5000 CASES[A]
9	1.5	3.75	$ 28.13
7	2.7	6.75	50.63
2	3.6	9.00	67.50
5	10.9	27.25	204.38
8	12.5	31.25	234.38
1	13.0	32.50	243.75
10	17.9	44.80	336.00
3	20.0	50.00	375.00
11	22.2	55.50	416.25
4	25.8	64.50	483.75
6	29.3	73.25	549.38
12	47.9	119.75	898.13
Average	17.3	43.25	$324.00

[A]Error cost was calculated at $0.25/doz, estimating a 5% undergrade rate.

Conclusions and Applications

1. Overpull can be a significant cost in commercial egg processing plants.
2. Quality control programs to monitor candling errors would seem advisable to limit overpulling losses.
3. Candlers should be trained to rapidly and confidently identify pseudo-defects which cause overpulling without dramatically increasing underpulling.
4. Automatic detection devices will be needed to support future high-speed cartoning equipment.

References and Notes

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