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Improving the Keeping Quality and the Market Value of Eggs By Proper Cleaning

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UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE

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Improving the Keeping Quality and the Market Value of Eggs By Proper Cleaning

E. M. Funk*

The poultry industry suffers annually a loss of several million dollars because dirty eggs are marketed as such or because they are improperly cleaned. Realizing the importance of this problem to the poultry industry of Missouri and to the nation, the Missouri Agricultural Experiment Station began in 1935 a series of investigations on the production and marketing of quality eggs. Bulletin 384 of this Station reported the results found relative to the factors influencing the production of clean eggs.

Under the best programs of poultry farm management some eggs become soiled, while under average farm conditions about twenty-five per cent of the eggs produced are dirty or slightly dirty. The disposal of dirty eggs has been a serious problem for the producer, the packer, the wholesale receiver, and the retailer. The producer has used different methods for cleaning the dirty eggs with various degrees of success.

PLAN OF EXPERIMENT

The eggs used in this investigation were treated and stored in April, 1936 and in April, 1937. The eggs were purchased from the F. M. Stamper Company, Moberly, Missouri, poultry and egg packing plant. The eggs were stored in St. Louis. Samples were removed at four week intervals over a period of six months in 1936 and over a period of ten months in 1937 and examined by candling and breaking. The results obtained in 1936 indicated that lye water (sodium hydroxide dissolved in water) was effective in cleaning eggs and in preventing loss in eggs which were stored. Therefore, this material was used with larger numbers of eggs in 1937. This material is effective, odorless, and inexpensive. In 1937 cooking tests were made to test the edible properties of the eggs. Eggs were also sold by grade in the St. Louis market to determine the market value of the eggs in the various lots.

*In addition to valuable assistance rendered by various departments of the Missouri College of Agriculture, grateful acknowledgment is made to the following: The F. M. Stamper Company, Moberly, Missouri, contributed the use of their plant and labor for cleaning the eggs in 1937. Royal H. Switzler, Vice-President and General Manager of the St. Louis Refrigerating and Cold Storage Company, very kindly provided storage space for sixty cases of eggs as long as needed. Mr. A. D. Greenlee of the Greenlee Products Company, St. Louis, Missouri, permitted the use of his plant for grading and breaking eggs.

TABLE 1.—RESULTS OBTAINED BY CANDLING EGGS AFTER 8 MONTHS STORAGE. ST. LOUIS, NOVEMBER 17, 1937.

Lot	Condition and Treatment of Eggs	Eggs Examined	Sound and Clean Shells			Edible Checks		Edible Dirties			Inedibles
			1st	2nd	3rd	2nd	3rd	1st	2nd	3rd	
B	Clean.	1440	1334	63	9	30	2				2
C	Clean, washed in water.	1382	1299	21	2	46	3				11
D	Dirty.	1440				37	1	1281	102	14	5
E	Dirty, washed in water.	1404	1027	252	32	14	7				72
F	Dirty, washed in water containing 1.0 per cent NaOH.	1440	1280	45	3	91	9				13
G	Dirty, washed in water containing .50 per cent NaOH.	1440	1201	67	4	110	23				35
H	Dirty, washed in water containing .25 per cent NaOH.	1080	870	40	4	118	12				36
I	Dirty, washed in water containing 1.0 per cent NaOH.	1439	1267	45	5	111	4				8
Price received per dozen.			.20	.16	.12	.16	.12	.16	.16	.12	

The grades first, second, and third were those used by the St. Louis firm that purchased the eggs.

RESULTS OBTAINED

Comparison of Quality

It soon became apparent that candling could not be relied upon as a scientific method for determining the edibility of the eggs and therefore most of the eggs were broken out also and observed for their edible qualities. Table 1 shows the results of candling and grading the eggs in the various lots removed from storage after an eight months storage period in 1937. This candling and grading was done by experienced persons in the St. Louis market. It will be observed that the eggs which had been cleaned by washing with water containing 1.0 per cent sodium hydroxide graded as clean eggs and that their interior quality was apparently equal to that of clean eggs held under the same condition. Table 2 and Figure 1 show the inedibles or loss found by candling and breaking out the

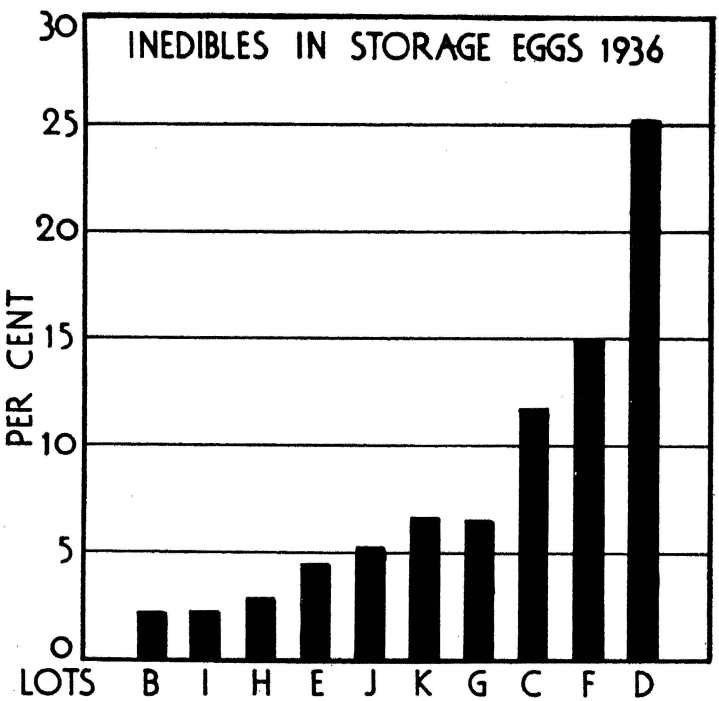

Fig. 1. Inedible eggs found in the different lots stored in 1936. B, clean; I, dirty eggs washed in water containing .35% NaOH; H, dirty eggs washed with water containing .7% NaOH; E, clean eggs washed with water; J, dirty eggs washed with ethyl alcohol (70%); K, dirty eggs washed in water and dipped in chlorine solution (.075%); G, dirty eggs washed with chlorine solution (.15%); C, clean eggs washed with water; F, dirty eggs washed with chlorine solution (.075%); D, dirty eggs washed with water.

TABLE 2.—INEDIBLE EGGS FOUND BY CANDLING AND BREAKING. 1936.

		Candling Results					Additional inedibles found when broken out.			Total Inedibles	
					Less edible eggs found when broken out.						
			Inedibles		Actual inedibles found by candling			Inedible			
Lot	Condition and treatment of eggs.	Number eggs candled	No.	Per Cent	No.	Per Cent	Number eggs broken	Number	Per Cent	Number	Per Cent
B	Clean eggs.	180	1	.56	None		136	4	2.94	4	2.22
C	Clean eggs washed with water.	179	10	5.59	8	4.47	131	13	9.92	21	11.73
D	Dirty eggs washed with water.	178	18	10.10	15	8.43	131	30	22.90	45	25.28
E	Clean eggs washed with water.	180	5	2.78	4	2.22	136	4	2.94	8	4.44
F	Dirty eggs washed with chlorine solution (.075%).	180	7	3.89	3	1.67	133	24	18.05	27	15.00
G	Dirty eggs washed with chlorine solution (.15%).	167	6	3.59	2	1.20	129	9	6.98	11	6.59
H	Dirty eggs washed with water containing .7% NaOH.	180	None		None		138	5	3.62	5	2.78
I	Dirty eggs washed in water containing .35% NaOH.	180	1	.56	None		132	4	3.03	4	2.22
J	Dirty eggs washed with ethyl alcohol (70%).	174	3	1.72	1	.57	132	8	6.06	9	5.17
K	Dirty eggs washed in water and dipped in chlorine solution (.075%).	180	4	2.22	1	.56	135	11	8.15	12	6.67

eggs in the 1936 experiment. It is evident that dirty eggs or clean eggs cannot be washed with water without injuring their keeping quality. These results, however, do show that by cleaning dirty eggs with water containing .7 per cent and .35 per cent sodium hydroxide their edible properties may be preserved and that the loss in these eggs may not exceed that found in clean unwashed eggs.

Appearance of Washed Eggs

One of the objections raised against washing eggs has been that it destroys the natural bloom of the eggs and thereby mars their appearance. Several lots of washed and clean unwashed eggs which had been in storage several months were examined by experienced observers. They were unable to detect the washed eggs by observation. Experienced egg candlers in the St. Louis market were unable to detect the washed eggs by candling. It therefore appears that dirty eggs can be cleaned in such a way that experienced observers and candlers cannot detect the eggs which have been washed.

Figure 2 attempts to show the appearance of the clean, dirty and washed eggs as they were removed from storage. It will be evident to the reader that the dirty eggs (lot D) were only slightly dirty. They were sufficiently dirty, however, to be classified as dirties when

Fig. 2. Eggs removed from lots B, D and F after 24 weeks storage. B, clean eggs; D, dirty eggs; and F, dirty eggs washed in water containing one per cent NaOH.

sold by grade. It was impossible for experienced candlers to identify washed eggs in lots such as F from clean eggs such as those in lot B.

Cooking Tests, 1937

As an additional test of edibility, samples of eggs were submitted to the Department of Home Economics at the end of eight and ten months storage for cooking and other tests of the edible qualities of the eggs. The Home Economics Department was not informed of the treatments given the various lots of eggs until several weeks after they completed their tests and reports. The report received on the eggs examined after eight months storage was as follows: "Observations for edible and cooking qualities of eggs from lots B, D, E and F showed some variations. Lot F ranked slightly the highest; in appearance and flavor of raw eggs, in thickening power and flavor when used in making custards, in general appearance and flavor of both yolk and white when poached, and in the volume of stiffness of the beaten white. There was a very slight but no consistent difference among the others."

This report indicated that the edible qualities of the eggs in lot F, the eggs cleaned with water containing 1.0 per cent sodium hydroxide, were equally as good as those of clean eggs.

At the end of ten months storage samples of eggs from all lots were submitted for examination by the Department of Home Economics. The report of these findings were as follows: "Observations for edible and cooking qualities of eggs from lots B, C, D, E, F, G, H, and I showed no consistent differences. In flavor of raw eggs, C, F, G and H were the best. In thickening power in custard H was the best with B and F next and the others much lower. In poached eggs H was best in flavor of yolk and ranked with C, F and G in appearance and flavor of white. In "hard cooked" eggs (just below the boiling point for 40 minutes) F and C were decidedly the best, G and H next and the other four poor. F and C were also best in volume and stiffness of beaten white. Considering all points then F, C and H would rank higher than the others."

Market Value of Eggs After Storage

The 1937 experiment was placed on a commercial basis so that the economic importance of the various methods of treatment might be evaluated in the regular egg markets. Therefore, several cases in each lot were stored for what is usually the maximum storage period

TABLE 3.—MARKET VALUE OF EGGS STORED EIGHT MONTHS. 1937. SOLD BY GRADES IN THE ST. LOUIS MARKET.

Lot	Condition and Treatment of Eggs	Eggs Stored	Sound-shelled Eggs Stored	Market Value (Dollars)		Average Price Per Doz.	
				All Eggs	Sound-shelled Eggs	All Eggs	Sound-shelled Eggs
B	Clean.	1440	1408	23.58	23.16	19.65	19.74
C	Clean, washed in water.	1382	1327	22.59	21.95	19.61	19.85
D	Dirty.	1440	1400	19.08	18.58	15.90	15.93
E	Dirty, washed in water.	1404	1347	21.06	20.80	18.00	18.53
F	Dirty, washed in water containing one per cent. NaOH.	1440	1330	23.25	21.96	19.37	19.81
G	Dirty, washed in water containing .50 per cent NaOH.	1440	1277	22.65	20.95	18.87	19.69
H	Dirty, washed in water containing .25 per cent NaOH.	1080	934	16.76	15.07	18.62	19.36
I	Dirty, washed in water containing one per cent NaOH.	1440	1318	23.29	21.77	19.41	19.82

(8 to 10 months) and sold by grade in the St. Louis market at prices the dealer considered fair for that season of the year. The number of eggs in each grade and the prices received for each grade are given in Table 1. The market value of the eggs in each lot are presented in Table 3. The average price per dozen has been calculated on the basis of all eggs stored and on the basis of the sound shelled eggs stored in each lot. It is evident from an examination of this table that cleaning the eggs with sodium hydroxide and water was highly profitable. While the dirty eggs averaged only 15.93 cents per dozen the dirty eggs which had been cleaned properly sold for 19.82 cents per dozen or almost four cents more per dozen than the dirty eggs. This represents an increased market value of almost $500 per car. When it is realized that approximately 50,000 cars of dirty eggs are produced in the United States annually, the magnitude of this loss may be grasped and the enormous savings from proper cleaning visualized. The results secured in this experiment indicate that dirty eggs can be cleaned so that they command not only a better price when sold as current receipts but also when they are removed from storage and sold by grade.

Effect of Washing on Loss in Weight of Eggs Held in Storage

One of the objections to washing eggs has been that washing destroys the protective covering of the eggs and that excessive evaporation follows. Table 4 shows the percentage loss of weight in clean unwashed eggs, clean eggs washed in water, and dirty eggs washed in water containing sodium hydroxide. The results showed

TABLE 4.—PERCENTAGE LOSS OF WEIGHT IN EGGS HELD IN COLD STORAGE FROM 1 TO 6 MONTHS. 1936. THIRTY EGGS WERE REMOVED FROM EACH LOT EVERY 28 DAYS AND WEIGHED.

Lot	Treatment	Months in Storage					
		1	2	3	4	5	6
B	Clean eggs.	(2) .54	1.68	2.09	(2) 2.63	(1) 3.25	3.15
C	Clean eggs washed with water.	.56	(1) 1.61	(1) 1.96	2.22	(1) 2.81	2.96
E	Clean eggs washed with water.	.33	1.68	1.77	1.55	2.99	(1) 2.95
H	Dirty eggs washed with water containing .7% NaOH.	.28	.92	1.39	1.76	(2) 2.26	(1) 2.26
I	Dirty eggs washed in water containing .35% NaOH.	.23	1.03	1.10	1.57	(1) 1.89	2.23
J	Dirty eggs washed with ethyl alcohol (70%).	(2) .28	.91	(1) 1.27	1.72	2.03	2.27
K	Dirty eggs washed in water and dipped in chlorine solution (.075%).	.39	1.25	1.69	1.83	2.43	(1) 2.74

Checked eggs found in each lot are indicated in ( ).

that washing did not cause an increase in loss of weight when eggs were stored.

Quality Determinations Made on Cold Storage Eggs

That the quality of an egg is best when the egg is laid and that time can only reduce that quality is generally conceded. The rate at which an egg loses quality depends upon such environmental factors as temperature, humidity, air composition, and exposure to infective agents. That shell eggs may be held for several months under proper refrigeration and yet retain their quality to a remarkable degree is generally known by those engaged in marketing eggs.

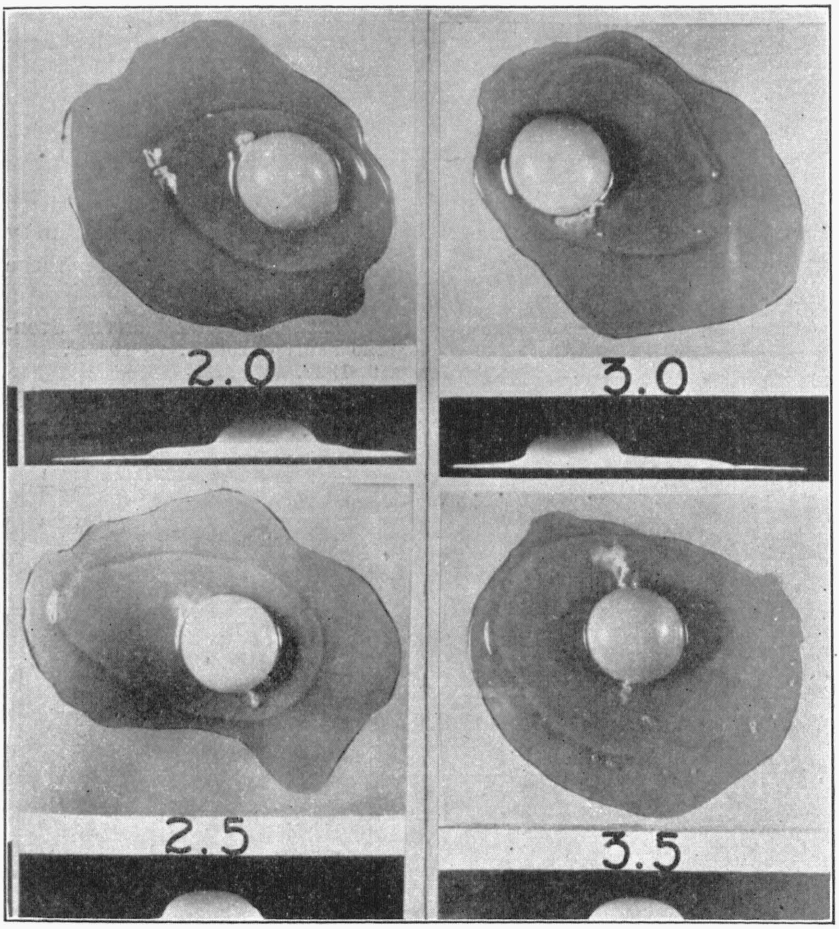

Fig. 3. The Cornell charts used in determining the Cornell scores.

To expedite the quality determinations, the charts prepared by Cornell University were used. These charts range from 1.0 (the highest quality fresh eggs) to 5.0 (the lowest quality edible eggs). Eggs broken out were given a score on these charts. When the eggs were stored their average score was 2.09. The scores tended to increase as time in storage lapsed and after 32 weeks storage the average score was 3.34. Clean eggs and those properly cleaned shifted in score slightly more than one point during the eight months storage period but lots C and E, which were cleaned with water, increased in score almost 1.5 points. The change in quality may be more clearly understood by referring to Figure 3 which shows the quality of the eggs. Since these values were assigned by the same person and one who did not know the treatments given the various lots, there would appear to be some significance in these differences.

Bacterial Count of Frozen Eggs Which Were Cleaned Before Breaking, 1937

Dirty shell eggs are used quite generally in the frozen egg industry. This has been one satisfactory way of disposing of dirty eggs during the spring and summer months when most of these

TABLE 5.—BACTERIAL COUNT OF FROZEN EGGS, AFTER NINE MONTHS STORAGE WHERE THE TEMPERATURE VARIED FROM —10° F. TO 10° F. FROZEN APRIL 9, 1937.

Lot	Treatment	Location of Sample	Bacteria Per Gram At 37° C.
A	Dirty eggs washed in water containing one per cent NaOH.	Center—Top	65,406
		Center—Middle	54,711
		Center—Bottom	2,863
		Side—Top	43,896
		Side—Middle	34,353
		Side—Bottom	59,800
	Average		43,504
B	Dirty eggs washed in tap water.	Center—Top	68,388
		Center—Middle	229,022
		Center—Bottom	25,765
		Side—Top	54,075
		Side—Middle	57,255
		Side—Bottom	26,401
	Average		76,818
C	Dirty eggs.	Center—Top	17,495
		Center—Middle	69,661
		Center—Bottom	134,550
		Side—Top	97,970
		Side—Middle	216,298
		Side—Bottom	24,811
	Average		93,465

eggs are produced. To test the effect of cleaning dirty eggs before breaking on the bacterial count of the resulting frozen egg product, dirty eggs were cleaned with water and with water containing one per cent sodium hydroxide and the bacterial count of these eggs determined at the end of nine months storage. The eggs were cleaned in the F. M. Stamper Packing Plant, Moberly, Missouri, and the whole eggs broken into sterilized standard containers in the egg breaking room of the same plant. The samples for bacterial analysis were removed with a sterile auger bit from the center and near the sides of the standard thirty pound can at levels near the top, middle, and bottom of the can. The bacterial content of the samples removed are given in Table 5. From the results secured it appears that the bacterial count of frozen eggs was reduced by cleaning the eggs properly before they were broken. As the bacterial count becomes more important in commercial transactions in frozen egg products, the method of cleaning discussed in this publication may have widespread application in the frozen egg industry.

Effective Solutions Necessary

While lye water is a rather stable solution if mixed with sufficient inert material it will lose its power as a disinfectant. In this experiment as many as 180 dirty eggs were cleaned in three quarts of water which contained .35 per cent sodium hydroxide with results which showed that the solution was effective. It should be kept in mind that unless effective solutions are used more harm than good will result from washing. The water containing sodium hydroxide used in washing eggs should be changed often so that the eggs washed are thoroughly cleaned of all contamination. Rubber gloves must be used by those washing eggs with lye water.

Effect of Prices Paid for Clean and Dirty Eggs on the Cleaning of Eggs by Producers

Consumers prefer clean eggs and they are willing to pay several cents more per dozen for clean eggs than for dirty eggs. Such differentials will always prevail in the retail markets where these eggs are sold. When such differentials are found in the prices paid producers very few dirty eggs are delivered to these markets because the producers clean the eggs. If these price differences are reduced or eliminated the producers cease cleaning eggs and de-

liver the eggs as found in the nests. The response of California producers to price differences for clean and dirty eggs is illustrated by facts from page 18 of U. S. D. A. circular 111, which show that in 1920 when rather wide differences in price prevailed only 2.3 per cent of the eggs delivered by the producers were dirty, whereas in 1925 when there was very little difference in the prices paid for clean and dirty eggs, 23.9 per cent of the eggs delivered were dirty.

Therefore it appears that producers may very easily be kept from cleaning eggs by merely reducing the difference paid for clean and dirty eggs to a point where producers cannot afford to clean the eggs for the premium paid for clean eggs.

Effect of Dirty Eggs on Consumer Demand

Since consumers do discriminate against dirty eggs to the extent of paying several cents more per dozen for clean eggs, it seems logical to assume that dirty eggs are a depressing factor on consumer demand and therefore tend to reduce the demand. The elimination of dirty eggs from the regular retail channels should stimulate shell egg consumption.

SUMMARY

The poultry industry of the United States loses several million dollars annually because of the marketing of dirty or improperly cleaned eggs.

Evidence presented here shows that dirty eggs can be effectively cleaned by using solutions of sodium hydroxide.

Soiled eggs cleaned with sodium hydroxide solutions kept equally as well in cold storage as clean eggs which were not washed.

Dirty eggs properly cleaned when removed from storage commanded prices equivalent to those obtained for clean eggs stored at the same time.

Cooking tests applied to the different lots of eggs after 8 and 10 months storage showed that dirty eggs which were properly cleaned possessed edible qualities equally as good as those of clean eggs.

Evidence is also presented which shows that the bacterial count of frozen eggs was significantly reduced by cleaning the eggs with a sodium hydroxide solution before the eggs were broken.

To obtain satisfactory results solutions sufficiently strong to be effective must be used.