Coating Effect on Storage Quality of Eggs at 4 ^{0} C and Room Temperature

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Introduction

Most of the studies concerning coating and fractured force of shell have utilized hen's eggs. Moreover, preservation of eggs by coating with mineral oil is prohibited by international food and nutrition laws (1). The effect of coating on shell strength has been reported by many scientists (2,3). Tanabe et al (4) stated that oil treatments reduced the incidence of rotten eggs and collapsed yolks during storage in summer. The effect of coating or oiling on weight loss and interior quality of new eggs has been reported by various authors (4-10). The values reported in a review for polar fracture force of egg shell vary by a factor of more than 70 (11). High humidity reduced the fracture forces (12). However Ball et al (13) reported that water immersion had no effect on fracture force of hen's eggs. Increasing temperature of dry eggs about 20^{0} C above ambient temperature resulted in significantly lowering of fracture force in hengs egg (14).

The present study was undertaken to obtain more information of a growing interest in newer coating materials since adequate experimental data concerning coating and fractured forces of quail eggs are lacking.

Materials and Methods

Four weeks old quail female were kept in wire floor cages and fed a diet containing 3.5% calcium. The room temperature was maintained at 22^{0} C. Eggs were collected in the afternoon of each day, inspected, weighed, washed at 60^{0} C, dried, and coated with a fermented starch and vegetable oil emulsion (consisted of vegetable oil, water, sorbitan, fatty acid ester and fermented starch) 15 to 20 mg/egg using mechanical brushing and then packed into eggs cartoons. Some coated eggs and controls were then stored at room temperature and others in a refrigerator at 4^{0} C for 2 months and periodically examined for weight loss, fractured force and interior quality. The humidity in the refrigerator varied in the range of 5 to 25% and the laboratory humidity was 20-30%, higher than the refrigerator's humidity.

Samples of 50 coated and uncoated eggs were examined for each storage period. The surface of each egg was wiped with a sterilized cotton piece moistened with 70% ethanol and aseptically broken out into a sterilized polyethylene bag. After being examined for appearance and odor to detect rotten eggs, the eggs contents were homogenized in a

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stomacher (A.J. Seward, London). Total bacterial count and coliform counts were ferformed. Three to five strains of representative colonies were picked from the plates and were identified by the method of Vanderzant and Nickelson (15) and Cowan and Steel (16).

Batches of 25 eggs were used to measure the weight loss and fractured force. The eggs were fractured with the polar axis horizontal, between two surface ground plates in a M.T.S. system 910 electrohydrautic closed loop machine. Then force and displacement were recorded. All the eggs were tested at velocity of 40um/sec. and weight loss was calculated following the equation of Kondalah et al (17).

Results

The range of bacterial count of coated eggs was 2.2 X 10^2- 4.2 X 10^4 and uncoated eggs was 1.1 X 10^2- 1.5 X 10^3 after one week at room temperature (Table--I). Table II shows the microflora found in the contents of coated and and uncoated eggs stored at room temperature and the Table III indicates the effect of coating on rotten eggs and bacteria contaminated eggs stored at 4^0C. Table IV summarizes the microbial flora of the eggs stored at 4^0C and Table V demonstrates the effect of coating on weight loss and interior quality of the eggs stored at 4^0C and at room temperature . Fig. I shows the changes in fracture force of coated and uncoated eggs stored at 4^0C and room temperature for two weeks.

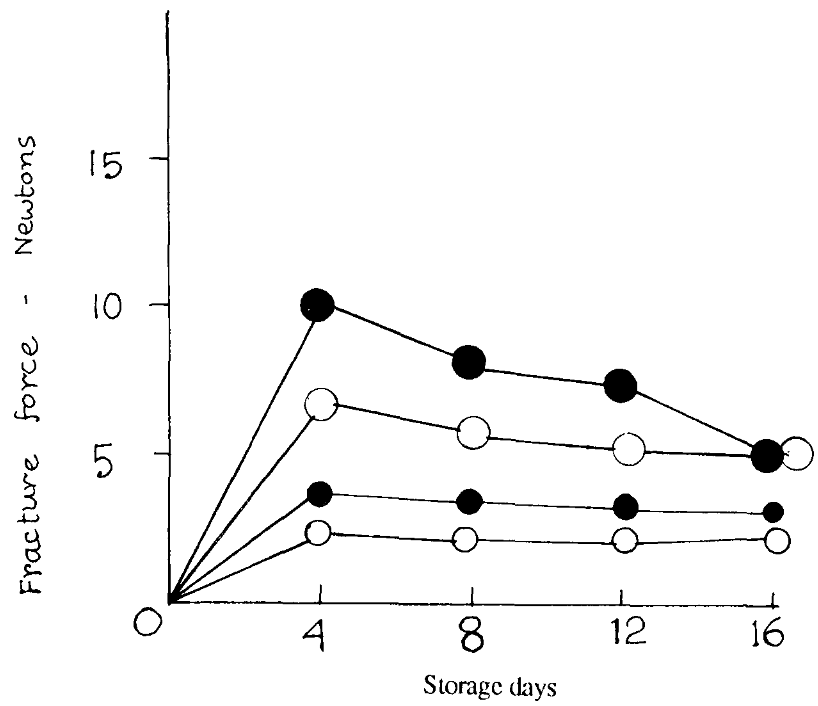

Figure : I Change in fracture force in coated and uncoated eggs with time of storage at 4° C and room temperature.

(Large closed circle= Uncoated eggs stored at room temperature, Large open circle= Undoated eggs stored at 4^0 C, Small closed circle circle= Coated eggs stored at room temperature, Small open circle= Coated eggs stored at 4^0 C.)

Discussion

Before storage, bacteria were not detected in 97% of either coated or uncoated eggs. The number of contaminated eggs increased with the storage period. The percentage or rotten eggs and bacteria contaminated eggs was not reduced by coating (Table I). The method used in this investigation could not show increased storage stability. The self life of quail eggs should be maximum of 14 days at room temperature in summer (18). It was also stated by Imai (19) that self life of both coated and uncoated eggs seemed to be limited to a week during the months of July.

Table II shows the predominant microflora in the contents of coated and uncoated eggs stored at room temperature were Gram negative bacteria such as Aeromonas, Flarobacterium, Acinetobacter and Alcaligenes. Gram negative bacteria were predominant in rotten eggs according to the report of Florian and Trussel (20) and stadelman (22). It was though that gram positive bacteria may be inhibited by the lysozyme present in egg white. Table III shows the effect of coating on rotten eggs and bacteria contaminated eggs during storage. At 4^0 C and room temperature, coating had no effect on the enterior quality of the eggs. Storage of coated or uncoated eggs in refrigerator was very effective compared with storage at room temperature in case of hen egg(22). The eggs stored at 4^0 C for 1 month were comparatively better to those stored for 2 weeks at room temperature (23). It was calculated that the self life of both uncoated and coated eggs seemed to be limited from 1-2 months at low temperature. Table 4 shows the microbial flora of the eggs stored of 4^0 C were Gram negative bacteria, specially psychrophylic bacteria were predominant in these samples. The beneficial effect of coating was marked at 4^0 C (Table V). The quality of eggs stored for 3 months at 4° C were comparable to those stored for 2 weeks at room temperature. From these experiments it appears that the self life of shell eggs could not be prolonged by coating, but refrigerated temperature was more effective and useful for storage of quail eggs. Fig. I shows the changes in fracture force of eggs stored at 4^0 C and room temperature. The mean fracture force as shown in curves (Fig. I) increased from 1-4 at room temperature. Most of the decline in fracture force occurred between storage period of 8 to 10 days at 4^0 C. There was no direct effect of coating on storage temperature. Hodges (24) and Carter (25) concluded that the cracking of hen's egg on boiling was due to insufficient release of internal pressure, created by expansion of the egg contents through the membranes and pores. Brook (26) suggested that loss of internal support due to evaporation and consequent loss of internal mass after the eight day might be responsible for the decline. Carter (27) found that the incidence of cracking of eggs stored at room temperature was very high in fresh eggs, peaked after days and it was low after 21 days. The results stated above were similar to those of our study in describing the air cell in the eggs increased in size and created more room for expansion within the egg. Thus fresh eggs released internal pressure through the membrance and pore, while old eggs were able to accommodate expansion of the egg contents.

It is concluded that the coating of eggs would not prolong shelf life of shell eggs, but it would be effective in reducing weight loss and in maintaining interior quality during storage and transport.

Table I *Coating effect on eggs stored at room temperature* [(a)]

Obsevation	Sample	Days of Storage' (Weeks)				
		0	1	2	3	4
% of rotten	Coated	0	0	3	4	6
eggs [(b)]	Uncoated	0	0	1	2	7
% of becteria contaminated	Coated	0	5	10	15	18
eggs [(c)]	Uncoated	0	1	7	10	15
Range of becterial counts	Coated	0	$2.2X10^2$ -- $4.2X10^4$	$2.0X10^2$ -- $5.0X10^8$	$7.0X10^2$ -- $6.2X10^7$	$1.0X10^2$ -- 7.5X
% gm in contaminated eggs	Uncoated	0	$1.1X10^2$ -- $1.5X10^3$	$4.0X10^3$ -- $6.2X10^7$	$5.0X10^3$ -- $1.0X10^8$	$4.5X10^2$ -- 1.5X

(a) in August. (b) Lots of 50 eggs. (c) Including rotten eggs.

Table II *Bacterial survey of the eggs stored at room tenperature*

Bacteria	Eggs	Days of storages (weeks) 1	2	3	4
Acinetobacter	Coated	A	A	B	C
	Uncoated	–	–	–	–
Aromonas	Coated	–	A	B	C
	Uncoated	–	B	B	D
Pseudomonas	Coated	–	A	B	C
	Uncoated	–	–	B	D
Flavobactorium	Coated	A	A	B	D
	Uncoated	–	–	B	D
Alcaligenes	Coated	A	D	D	D
	Uncoated	A	D	D	D
Enterobacter	Coated	A	–	–	–
	Uncoated	A	–	–	–

A = $1.0X10^{2}$/gm, B = $1.1X10^{2}$/gm--$1.0X10^{4}$/gm, C = $1.1X10^{4}$/gm--$1.0X10^{6}$/gm, D = $1.1X10^{5}$/gm--$1.5X10^{6}$/gm

Table III *Coating effect on eggs stored at room temperature* [a]

Observation	Sample	Days of Storage' (Weeks) 0	1	2	3	4
% of rotten eggs [(a)]	Coated	0	0	0	1	4
	Uncoated	0	0	0	1	4
% of becteria contaminated eggs [(b)]	Coated	0	2	4	5	6
	Uncoated	0	1	2	4	10
Range of becterial counts % gm in contaminated eggs.	Coated	0	$1.0X10^{2}$ -- $4.4X10^{2}$	$2.3X10^{3}$ -- $1.8X10^{6}$	$1.0X10^{3}$ -- $2.5X10^{7}$	$1.8X10^{3}$ -- $2.0X10^{7}$
	Uncoated	0	$3.2X10^{2}$ -- $3.6X10^{2}$	$3.0X10^{2}$ -- $2.6X10^{4}$	$2.2X10^{3}$ -- $2.9X10^{6}$	$2.0X10^{3}$ -- $2.5X10^{5}$

(a) Lots on 50 eggs. (b) Including rotten eggs.

Table IV *Bacterial survey of the eggs stored at 4^oC*

Bacteria	Eggs	Days of storages (weeks) 0	1	2	3	4
Acinetobacter	Coated	0	B	B	A	A
	Uncoated	0	B	B	D	B
Aromonas	Coated	0	A	B	B	B
	Uncoated	0	0	0	C	C
Pseudomonas	Coated	0	A	D	D	A
	Uncoated	0	0	C	D	A
Flavobactorium	Coated	0	0	0	C	A
	Uncoated	0	0	0	A	C
Alcaligenes	Coated	0	0	C	C	D
	Uncoated	0	0	A	A	B
Klebsiella	Coated	0	0	B	B	C
	Uncoated	0	0	0	B	C
Citobacter	Coated	0	0	0	B	C
	Uncoated	0	0	C	C	D

A = $1.0X10^2$/gm, B = $1.5X10^2$/gm--$1.0X10^4$/gm, C = $1.5X10^4$/gm--$1.5X10^6$/gm, D = $1.5X10^6$/gm.

Table V *Effect of Coating on Weight Loss*

Measurement of weight loss %	Sample	Days of storage '0 days	'7 days	'14 days	'21 days	' 2 months	'3 months
Eggs stored at 4° C	Coated	0.0 ± 00	0.22 ± 0.15	0.48 ± 0.25	0.95 ± 0.85	1.82 ± 0.65	2.20 ± 0.90
	Uncoated	0.0 ± 00	0.45 ± 0.35	0.75 ± 0.35	1.20 ± 0.65	2.90 ± 0.85	3.20 ± 1.50
Egg stored at room temperature	Coated	0.0 ± 00	0.95 ± 0.35	2.00 ± 9.0	2.99 ± 0.65	3.50 ± 2.00	4.50 ± 2.50
	Uncoated	0.0 ± 00	1.72 ± 0.65	3.20 ± 1.60	3.80 ± 1.70	4.50 ± 2.50	5.50 ± 2.60
Interior quality unit	Coated	62.0 ± 5.90	50.9 ± 4.56	45.6 ± 7.41	42.8 ± 8.78	38.0 ± 7.74	20.0 ± 6.20
	Uncoated	60.0 ± 4.90	52.9 ± 4.60	49.2 ± 7.20	43.0± 9.11	34.0 ± 7.50	20.0 ± 5.20

Mean ± standard deviation of 50 samples

Summary

Fresh quail eggs were coated with a coating emulsion made of vegetable oil and fermented starch and then stored in a refrigerator at 4^0 C and at room temperature to investigate the bacteriological stability, weight loss and fracture force.

Coating of eggs reduced the weight loss and fractured forces, but did not increase the bacteriological stability of shell eggs in maintaining the interior quality. The egg lost weight at a rate of roughly 1% per week. The fractured force increased to a maximum after 5 days of storage and then declined to a minimum at 14 days.

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