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A Study on Egg Preservation Using Different Concentration of Acetic Acid and Limestone Solution

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ABSTRACT: The art of egg preservation by dipping in limestone solution has been known for centuries and this traditional procedure which extend the shelf-life of fresh egg has not been subjected to scientific study. Accordingly, the potential exists to technology and shelf-life of fresh egg need to be explored. This study comprises of two experiments i.e. the combination of different concentration of acetic acid (1%, 2% and 3%) with 10%, 12.5%, and 15% limestone solution as the first experiment. while the second one used the same concentration of solutions but first the eggs were dipped in acetic acid solution, then in the limestone solution. Combination of 1% acetic acid and 12.5% limestone solution could significantly extend the shelf-life of fresh egg up to 10 days ($P<0.05$), while dipping the egg into 3% acetic acid solution then into 12.5% limestone solution can significantly extend the shelf-life up to 15 days ($P<0.05$).

Key Words: Egg Preservation, Concentrattion, Acetic Acid, Limestone

Introduction

Based on the protein demand in Indonesia, egg protein is one of the potential sources which should be fulfilled in daily diet. Because of the high nutrition value of egg, and of the structure, egg tend to be easily deteriorating, especialy in the tropical country such as Indonesia.

The shelf-life of eggs are not only depending on the size, but also on the environment condition where the eggs are stored. Chemical changing of eggs frequently happens during storage, i.e. loosing weight and carbondioxide, increasing the air space volume and pH, decreasing the specific gravity, and the yolk and the ovalbumin become liquified.

To prevent eggs from deteriotion, most people use acetic acid solution and or limestone solution as a traditional procedure. This has not been carried out scientifically. These technological approaches may be effective in improving shelf-life of eggs.

The use of acetic acid solution as preservation substance have some advantages i.e. cheap, and has the ability to decrease initial total microbial onto the egg shell surface. While the advantage of using limestone solution is to coat the egg shell. Besides that, limestone is also cheap and easily found in common market.

This study investigated the influence of using acetic acid solution and limestone solution as a dipping solution i.e by combining these two kinds of solution of dipping the eggs in acetic acid solution first then in limestone solution to improve the shelf-life.

Materials and Methods

One day old, *Leghorn* eggs which had the average weight of 57.13±3.11 g and in good condition was used in the experiment. The experimental design was a Complete Randomized Design with two factors: acetic acid solution (1.0%, 2.0%, and 3.0% w/v - labelled with A1, A2 and A3 respectively), and limestone solution (10.0%, 12.5% and 15% b/v - labelled with K1, K2 and K3 respectively). Through these factors there were 9 combinations of treatments (A_1K_1, A_1K_2, A_1K_3, A_2K_1, A_2K_2, A_2K_3, A_3K_1, A_3K_2, A_3K_3). Two methods were used in treating those eggs by dipping into the solution. The first was by dipping those eggs in each combination of solution for 15 minutes, and the second was by dipping those eggs in the following order: in acetic acid solution for 15 minutes, and then in limestone solution for 15 minutes.

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All of the eggs in treatment were stored in the room temperature (22°C), and observed after 5, 10, 15, 20, and 30 days by measuring the pH of ovalbumin, and *Haugh Unit* (Stadelman and Cotteril, 1973). Eggs would be catagorized into deteriorating eggs if the Haugh Unit score was below 50 (Buckle *et al.*, 1987).

Haugh Unit were calculated as follows:

$$H = 100 \log \left[h - \left\{ \frac{G(30W^{0.37} - 100)}{100} \right\} + 1.9 \right]$$

where:

H = Haugh Unit
h = height of ovalbumin
G = 32 if h in mm and W in g
W = weight of intact egg

The statistical tests employed in the analysis of the data were the Analysis of Variance and the Duncan's Test.

Result and Discussion

pH of ovalbumin

The pH of ovalbumin of the treated eggs were given in Table 1.

Table 1. The average pH value of Ovalbumin (Method I)

Acetic	Limestone	Days of storage					
Acid Sol	Sol.	5	10	15	20	25	30
1%	10.0%	8.74bcd	8.64b	9.37b	9.70b	9.71b	9.75b
	12.5%	8.49b	8.79bc	9.47b	9.64b	9.88b	10.31gh
	15.0%	9.04acdc	9.28acf	9.45b	9.76b	9.77b	9.99cde
2%	10.0%	8.72bc	8.92bcd	9.46b	9.45b	9.91b	9.94cd
	12.5%	9.61acde	9.04cdc	9.59b	9.67b	9.92b	9.88bc
	15.0%	9.28aef	9.52a	9.75b	9.77b	10.07a	10.32ghi
3%	10.0%	9.33a	9.43afgh	9.78a	9.84b	9.93b	10.14cf
	12.5%	9.11acdc	9.47afgh	9.63b	9.93a	9.89b	10.49a
	15.0%	9.02acde	9.32acfg	9.57b	9.81b	10.00b	10.18fg

The same alphabetic order next to the average value are not significantly different (P>0.005)

Table 2. The Average pH value of Ovalbumin (Method II)

Acetic	Limestone	Days of storage					
Acid Sol	Sol.	5	10	15	20	25	30
1%	10.0%	9.45a	9.51a	9.59a	9.77a	9.78a	9.97a
	12.5%	9.04cde	9.37b	9.45ab	9.64a	9.84a	10.00a
	15.0%	8.98def	9.35b	9.48ab	9.70a	9.79a	10.00a
2%	10.0%	9.20b	9.27bc	9.40bc	9.65a	9.87a	9.94a
	12.5%	8.93ef	9.30b	9.43bc	9.62a	9.89a	9.95a
	15.0%	8.64g	9.31b	9.44bc	9.61a	10.02a	9.94a
3%	10.0%	9.06cd	9.20cd	9.39bc	9.63a	9.90a	10.14a
	12.5%	8.90f	9.11d	9.30c	9.52a	9.86a	10.18a
	15.0%	9.15bc	9.34b	9.53ab	9.78s	9.97	10.26a

The same alphabetic order next to the average value are not significantly different (P>0.005)

Based on the statistical analysis, dipping eggs in the variable concentration gave a significant difference to the pH's ovalbumin ($P<0.05$) after 5 and 10 days of storage (Table 1). By dipping the eggs into acetic acid solution, reaction between $CaCO_3$ and acetic occured onto the egg shell, and the calcium substance will be diluted (Vogel, 1976). Such condition made the egg shell thinner and the pore became wider; the water biologically evaporated rapidly. This happened continuously, and the buffer system was destroyed, and the pH of ovalbumin increased in line with the age of eggs. Penetration of acetic solution into the ovalbumin was still possible, this condition would destroy the buffer system of eggs (Winarno, 1986).

Dipping the eggs into various concentration of limestone solution gave a highly significant difference ($P<0.05$) to the increasing of pH of ovalbumin until 10 days. Reaction between CO_2 and $Ca(OH)_2$ gave $CaCO_3$; this substance coated the egg shell pore and the evaporation could be inhibited (Romanoff and Romanoff, 1963).

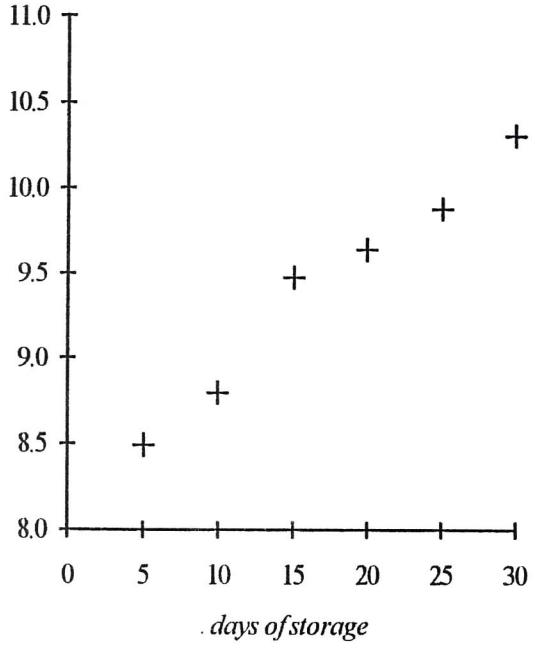

Figure 1. Relationship between days of storage of eggs and pH to the combination treatment of 1% acetic acid and 12.5% limestone sol. (Method I)

Combination treatments which were subjected to the eggs showed significant difference ($P<0.05$) to the pH of ovalbumin. Combination of A1K1 was not significantly different to A2K1 and A1K2, this meant that the eggs could be preserved by this combination up to 10 days of storage. The normal ovalbumin pH of a normal egg was 8.6 - 8.9. The influence of dipping the eggs in 1% acetic acid solution and 12.5% limestone solution tended to be the best treatment to keep the pH relatively constant (Figure 1.)

Based on the statistical analysis of variance, egg treated with acetic solution and limestone in different order from the first method, combined with the treatment A3K3 could sustain the ovalbumin pH only for 5 days of storage (Figure 2.)

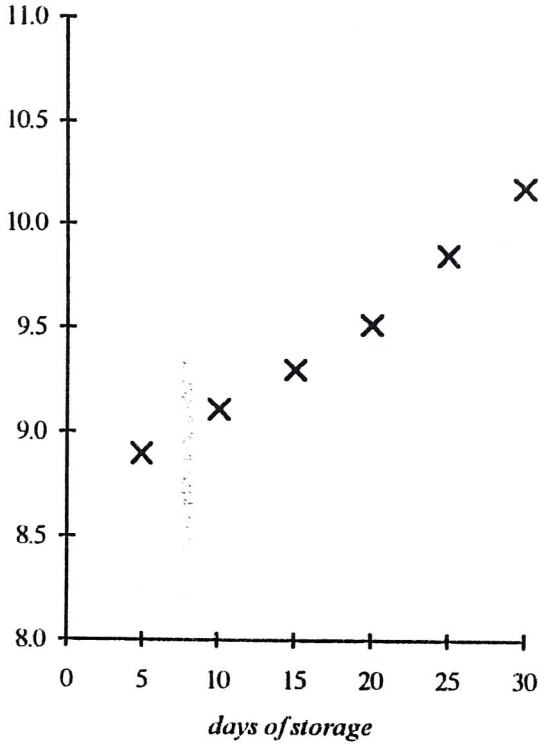

Figure 2. Relationship between days of storage of eggs and pH to the combination treatment of 3% acetic acid and 12.5% limestone sol. in different order (Method II)

Haugh Unit

The Haugh Unit of the eggs in treatment were given in Table 3 and Table 4. Based on the Analysis of Variance, there are significant differences among the treatments on Haugh Unit due to dipping eggs on acetic acid solution ($P<0.05$). Because of the penetration of acetic acid into the eggs, the ovalbumin pH increasing, and the Haugh Unit decreased.

The Haugh Unit significantly decreased ($P<0.05$) due to the effect of limestone solution; but the combining of treatment would preserve the eggs up to 20 days. Combination of A2K3 was the best treatment and not significantly different from A1K3, A2K1, A1K1, A1K2, A2K2, A3K1, A3K3 and A3K2. All of these showed that Haugh Unit could reach more than 50, this meant that the treated eggs were in a good condition (Buckle *et al.*, 1987)

Eggs treated by dipping 3% acetic acid solution first, and then 12.5% limestone solution significantly extended the shelf-life upt o 15 days. Relationship between days of storage and Haugh Unit was presented in Figure 3 and Figure 4.

Table 3. The Average Value of Haugh Unit (Method I)

Acetic Acid Sol	Limestone Sol.	Days of storage					
		5	10	15	20	25	30
1%	10.0%	77.30a	71.98a	64.26a	61.45a	48.94a	28.54cd
	12.5%	76.59a	73.37a	65.47a	59.42a	46.09b	35.15a
	15.0%	72.48a	71.35a	64.72a	63.42a	48.00b	28.77cd
2%	10.0%	73.55a	73.50a	62.96a	61.61a	47.24b	27.76bcd
	12.5%	74.65a	74.58a	62.92a	58.41a	43.92b	29.12cd
	15.0%	72.81a	72.71a	64.88a	52.61a	40.81b	23.19bc
3%	10.0%	73.85a	72.93a	65.99a	56.97a	37.11b	17.65b
	12.5%	72.19a	70.48a	63.54a	52.63a	42.14b	27.97bcd
	15.0%	74.94a	70.10a	64.02a	52.84a	40.00b	24.30bcd

The same alphabetic order next to the average value are not significantly different ($P>0.005$)

Table 4. The Average Value of Haugh Unit (Method II)

Acetic Acid Sol	Limestone Sol.	Days of storage					
		5	10	15	20	25	30
1%	10.0%	82.47a	80.81a	47.65b	49.52a	38.20a	26.31ad
	12.5%	82.55b	68.70b	47.37b	49.20a	39.28a	11.44a
	15.0%	82.67b	71.74b	69.06b	49.58a	40.99a	15.71a
2%	10.0%	76.64c	61.41c	55.56ab	45.43a	34.02a	15.71a
	12.5%	86.80a	71.48b	53.38ab	44.97a	28.51a	22.97a
	15.0%	83.02b	69.71b	58.53ab	42.35a	33.60a	19.64a
3%	10.0%	84.43ab	73.09b	59.67ab	52.04a	39.51a	24.54a
	12.5%	83.92ab	76.81ab	69.57a	57.49a	46.43a	20.44a
	15.0%	74.94ab	76.19ab	63.16ab	48.28a	38.35a	12.31a

The same alphabetic order next to the average value are not significantly different ($P>0.005$)

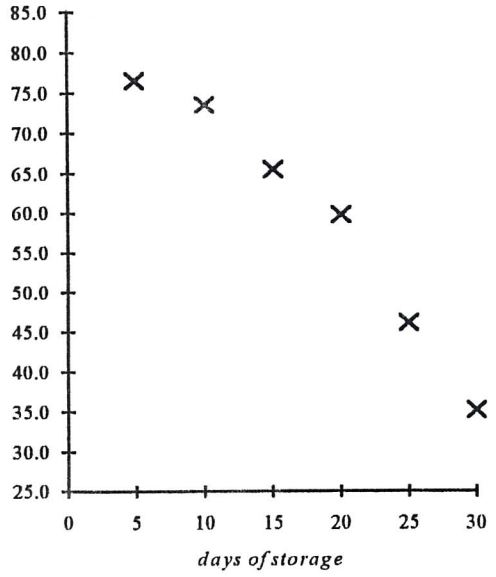

Figure 3. Relationship between days of storage of eggs and Haugh Unit to the combination treatment of 1% acetic acid and 12.5% limestone sol. (Method I)

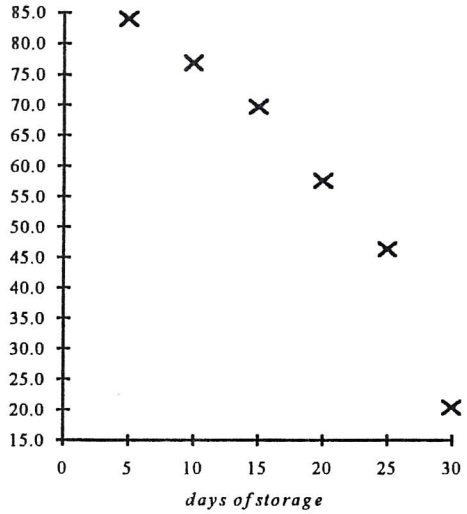

Figure 4. Relationship between days of storage of eggs and Haugh Unit to the combination treatment of 3% acetic acid and 12.5% limestone sol. (Method II)

Conclusion

Combination between 1% acetic acid solution and 12.5% limestone solution appeared beneficial for the preservative effect to extend the shelf-life of fresh eggs up to 20 days, but by dipping eggs into 3% acetic acid solution and 12.5% limestone solution in orderly procedure could also be used as a preservative agent to extend shelf-life of fresh eggs up to 15 days.

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References

Buckle, K.A., Edwards, R.A., Fleet, G.H., and Wooton, M., translated by Purnomo, H., and Adiono. 1987. Ilmu Pangan Penerbit Universitas Indonesia, Jakarta.

Romanoff, A.L. and Romanoff, A.J., 1963. The Avian Egg. Second Printing. John Wiley and Sons, Inc. New York.

Stadelman, W.J. and Coterril, O.J., 1973. Egg Science and Technology. The AVI Publishing COmpany, Inc. Westpoint, Connecticut.

Winarno, F.G., 1986. Kimia Pangan dan Gizi Edisi ke 2. PT. Gramedia. Jakarta.