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Effect of Preservative Agents on Qualities of Table Eggs

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Target Audience: Animal Scientist, Poultry Farmers, Egg Dealers, Nutritionists and Public Health Agents

Abstract

Effect of preservative agents on qualities of table eggs was observed using 320 eggs of Bovine brown layers in which the egg weight loss, air-cell volume and viscosity of the albumen were determined for a period of eight weeks. The results indicated significant differences (P<0.05) in the weight loss of eggs stored under the room temperature condition. The weight loss after the first four weeks was significantly high (P<0.05) and fell as the storage period progressed among the eggs stored under room temperature. The sealing agents had significant influence (P<0.05) in reducing weight loss in the eggs stored at in room temperature condition. The lowest weight loss of 1.48 ± 0.33g was observed from eggs sealed with oil. Increase in air cell volume was significantly high (P<0.05) at the last three weeks of storage in both the room and fridge conditions. Also sealing agents significantly reduced (P<.0.5) the air cell volume of eggs in both the room and fridge conditions. The viscosity of albumen was significantly preserved (P<0.05) by the sealing agents on the egg stored under the room temperature.

Keyword: Preservative agents, storage condition, table egg qualities.

Description of Problem

Egg production has witnessed dramatic changes over the years due to technology generated by such disciplines as genetics, nutrition and physiology which have replaced the crude management act of egg production (1, 2). However, increase in egg production in many parts of the world has resulted in problems such as egg glut especially where marketing of eggs is inefficient. In Nigeria, the problem is more pronounced due to inefficient distribution and marketing of eggs, low per capita egg consumption and low investment capacities among the retailers who play vital role in distribution of eggs from points of production to the point of consumption (3). Also, the demand for eggs appears to be seasonal. Between August and December, there are relatively high demand for eggs and retailers book in advance but between March to July, when some food items such as maize, groundnut, fruits and vegetables are readily available, the demand for eggs shift to these food items and people patronized those who sell them more than those who sell eggs (3). This results in low sales, long stay in the hand of retailers and eventually deterioration of eggs. It is common to find table eggs of low qualities being sold in many markets and consumed by many people in Nigeria (5).

Egg deterioration starts as soon as egg is laid. This occurs fast in high temperature (6). During this period, there is a breakdown of carbohydrate, fat and protein resulting in the degeneration of mucin fibre that held the albumen in gel form. Also there is biochemical reaction involving the breakdown of trioxocarbonate (iv) acid that produces carbon (iv) oxide and water. This process increases the P^{H} of liquid eggs and exposes the eggs to bacterial invasion (7). As gases escape through the pore, the content of eggs shrink and both the albumen and yolk also become watery because of the breakdown of trioxocarbonate (iv) acid and mucin fibre. Understanding the above process and retarding one or more of the above series of events could assist in determining the effectiveness of preservative methods or agents.

Materials and Methods

A total of 320 few hours laid eggs were randomly assigned to 2 x 5 factorial design experiment involving two storage conditions, each with four egg preservative treatments and one untreated egg preservative. Each treatment consisted of four replicates. A replicate was made up of 80 freshly laid crack free eggs from Bovine brown layers flock. The first replicated was collected from the flock when the layers were 36 weeks old. The other replicates were collected at one week interval, hence the layer were 36, 37, 38, 39 weeks respectively.

The storage condition involves fridge and room conditions. Large thermoline refrigerator with three refrigerating chambers capable of accommodating one thousand eggs per chamber was used for fridge condition while rats and insect proof room with two windows was used for the room storage condition.

There were a total of 64 eggs per egg preservative treatment. The preservative treatment include:-

Salt Solution: This was prepared by dissolving 58.6 grammes of common salt in $1dm^3$-distilled water. The eggs were dipped in the solutions, removed and allowed to drain and packed in a crate.

Ash Slurry: About 50 grammes of wood-ash was dissolved in $1dm^3$ distilled water and stirred, the eggs were dipped one after another in the slurry, drained and packed in the crates.

Oil: Vegetable oil (Life vegetable oil) was collected in $250cm^3$ beaker and the eggs were dipped one after another in the oil, drained and packed in the crates.

Polythene: A polythene seal involves provision of transparent polythene, which was used to wrap each of the eggs carefully and pack in the crate.

Unsealed egg: There were eggs that were not treated with any sealing agents and were regarded as unsealed eggs.

Data Collection: The eggs were reweighed after sealing using electronic balance. Subsequent weighing occurred at a weekly interval. The temperature and humidity of the two storage conditions were monitored on daily basis with maximum and minimum thermometer, Vernier Calliper was used to determine the egg length, width as well as its albumen and yolk size. The shell thickness, air cell volume was determined on weekly basis using Vernier Callipers. Also the viscosity of the albumen and yolk were determined with hydrometer.

The weight loss per egg was calculated from the difference between the final weight and initial weight of egg. The shape index was calculated by determining the ratio between the length and width of the egg; while the Haugh unit was calculated from the formular below

$$HU = 100 \log (H + 7.57 - 1.7w_0{:}37)$$

HU = Haugh unit

H = height of albumen

W_0 = Average weight of egg.

Least square mean and maximum likelihood computer programme was used for data analysis (8).

Result

Table 1. Least Square mean for weight loss per egg.

		Room condition	Fridge condition
Humidity %		55 ± 18	80 ± 5
Temperature C		28 ± 7	10 ± 3
Av. Egg wt. (g)		59 ± 5	
Av. Share index		1.5 ± 0.2	
Variable	N	x (g) ± S. E	x ± (g) ± S. E
Overall LSM	320	1.76 ± 0.12	1.46 ± 0.15
Week 1	80	2.87 ± 0.38^{b}	1.39 ± 0.82
2	80	2.33 ± 0.23^{b}	1.39 ± 0.26
3	80	1.94 ± 0.23^{b}	1.37 ± 0.20
4	80	1.81 ± 0.35^{b}	1.35 ± 0.20
5	80	1.64 ± 0.30^{ab}	1.35 ± 0.20
6	80	1.53 ± 0.31^{a}	1.14 ± 0.20
7	80	1.47 ± 0.31^{a}	1.14 ± 0.20
8	80	1.46 ± 0.23^{a}	1.13 ± 0.20
LSM Sealed	256	1.75 ± 0.30	1.46 ± 0.20
Unsealed	64	2.99 ± 0.27^{b}	1.57 ± 0.18
Salt	64	1.99 ± 0.43^{b}	1.49 ± 0.30
Ash	64	1.69 ± 0.20^{ab}	1.47 ± 0.30
Oil	64	1.85 ± 0.1^{a}	1.40 ± 0.11
Polythene	64	1.85 ± 0.15^{a}	1.48 ± 0.15

a, b mean in the same column with different superscript are significantly different (P<0.05).

Table 2: Least Square mean for air cell.

		Room Condition,	Fridge Condition
Humidity %		56 ± 18.0	80 ± 5.0
Temperature ⁰C		28 ± 7.0	10 ± 3.0
Av. Egg wt (g)	59 ± 5.0		
Av. Shape index	1.5 ± 0.20		
Variable	N	x (mm)^3 ± SE	x (mm)^3 ± SE
Overall LSM	320		
Week 1	80	0.95 ± 0.70	0.00
2	80	1.75 ± 0.38	1.25 ± 0.3
3	80	2.75 ± 46	1.50 ± 0.33
4	80	3.75 ± 0.52	2.05 ± 0.41
5	80	4.75 ± 0.68	3.00 ± 0.50
6	80	5.75 ± 0.89^b	4.50 ± 0.63^{ab}
7	80	7.75 ± 0.95^b	5.0 ± 0.73^b
8	80	8.47 ± 0.95^b	6.0 ± 0.95^{-b}
LSM Sealed	256	4.40 ± 38^a	3.55 ± 0.70^a
Unsealed	64	8.47 ± 0.95^b	5.12 ± 0.85^b
Salt	64	4.47 ± 0.95	3.82 ± 83
Ash	64	3.62 ± 0.41	3.75 ± 0.5
Oil	64	2.25 ± 0.62	2.12 ± 0.88
Polythene	64	6.87 ± 1.59	4.5 ± 0.15

a, b mean in the same column with different superscript are significantly different ($P<0.05$).

Table 3: Least Square mean for viscosity per egg.

		Room Condition,	Fridge Condition
Humidity %		56 ± 18.0	80 ± 5.0
Temperature °C		28 ± 7.0	10 ± 3.0
Av. Egg wt (g)	59 ± 5.0		
Shape index	1.5 ± 0.20		
Av. Haugh unit %	65.05		
Control viscosity	1.10		
Variable	N	x (N/m³) ± SE	x (N/m³) ± SE
Overall LSM	320	1.02 ± 3.0	1.06 ± 0.1
Week 1	80	1.0 ± 0.00	1.10 ± 0.0
2	80	1.09 ± 0.01	1.10 ± 0.01
3	80	1.08 ± 0.01	1.10 ± 0.01
4	80	1.08 ± 0.02	1.08 ± 0.02
5	80	1.06 ± 0.02	1.0 ± 0.01
6	80	1.04 ± 0.3	1.08 ± 0.02
7	80	1.03 ± 0.03	0.07 ± 0.02
8	80	1.01 ± 0.03	0.06 ± 0.22
LSM Sealed	256	1.05 ± 03[b]	1.05 ± 0.03
Unsealed	64	0.09 ± 0.03[a]	1.05 ± 0.02
Salt	64	1.04 ± 0.01	1.05 ± 0.01
Ash	64	1.05 ± 0.03	1.06 ± 0.2
Oil	64	1.08 ± 0.01	1.03 ± 0.01
Polythene	64	103 ± 0.03	1.03 ± 0.02

a, b mean in the same column with different superscript are significantly different ($P<0.05$)

In table 1, the weight loss is shown. There were significant differences ($P<0.05$) in the weight loss of eggs store under room temperature condition. The weight loss after the first few weeks of storage in room condition were high and began to fall as the storage period progressed. The reason could be explained from the fact that under normal condition, the cuticle, which acts as plug on the shell pore, began to dry and increase the shell porosity. Also the albumen gives off carbon (iv) oxide which passes through the pores. There is rapid loss of carbon (iv) oxide during the first few hours of lay, leading to loss in weight of egg (7). The sealing agent had significant influence ($P<0.05$) in reducing the weight loss. This is shown in oil sealed eggs, suggesting that it is a good sealing agent. Salt and polythene had high values of weight loss indicating that they are poor sealing agents. The action of sealing agents involves closing the pore of shell thereby preventing the escape of carbon (iv) oxide and moisture from the egg. Polythene and salt cannot perform such function by their nature and that is why the egg weight loss was high despite their application. Polythene did not allow the evaporation of moisture and escape of carbon (iv) oxide released from the eggs and cause the moisture to settle on the shell, which resulted in growth of fungi on the surface of the shell. The salt did not in any way seal the pore within the shell. There were generally low weight losses among eggs stored under refrigeration than those stored under room temperature. The values of the weight loss were further reduced in the eggs under sealed treatments and stored in the fridge. The reason could be explained from the fact that lower temperature retard the production of carbon (iv) oxide and evaporation of moisture form the eggs (6). Also at low temperature and high humidity, carbon (iv) oxide is more soluble, and the porosity on the shell is reduced because the cuticle does not dry out.

Table 2, shows the least square mean for air cell. The air cell occurs when the warm egg freshly laid cools and its content contract. Further more contraction depends on the escape of moisture from the egg due to evaporation. Evaporation also depends on the porosity of the shell resulting from the dryness of the cuticle. From the explanation above, the reason for the significant difference in the volume of air cell of the sealed and unsealed egg could be found.

Table 3 shows the least square means for the viscosity of albumen. Sealing agents significantly retain the viscosity of albumen. The reason for this could be explained from the fact that the sealing agents prevent the release of carbon (iv) oxide from the albumen, thereby maintaining the pH of eggs at stable rate and also preventing the breakdown of mucin fibre.

Conclusions and Application

1. Oil and ash appeared to have the potential in preserving the qualities of table eggs better than other agents such as salt, ash and polythene.
2. Low temperature and adequate humidity may help the sealing agents to preserve the quality of eggs.

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