Effects of Traditional Methods of Storage on Egg Quality

By

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SUMMARY

THE effectiveness of using maize starch, warm water, cold water, groundnut oil, palm oil and cold storage [refrigerator] in preserving the quality of eggs was studied. Groundnut oil, palm oil and cold storage were equally effective in preserving the quality of eggs while maize starch, cold water and warm water were found ineffective. The effectiveness of palm oil and groundnut oil was further enhanced when the oil-treated eggs were stored in the refrigerator for four weeks. Treatment with groundnut oil for one minute before storage for four weeks was considered the preferred method of preserving the quality of eggs.

INTRODUCTION

ALTHOUGH there is a rapid increase in egg production in Nigeria, not much attention has been paid to the problems of preservation and marketing of eggs. In Nigeria, in the movement of eggs from producer to consumer, eggs might be stored for long periods of time at room temperature (25°C; relative humidity of 61.7%) or in air conditioned rooms (18.2°C and relative humidity of 43%). These conditions of storage have been found unsuitable for preserving the quality of shell eggs for periods longer than one or two weeks respectively (Olomu, 1975). More suitable methods are therefore required if a high proportion of the original quality of shell eggs were to be maintained for periods longer than two weeks.

Methods of storage which have been proposed for preserving the quality of eggs have included coating with commercial oil (Kumar *et al.* 1969; Orr and Fletcher, 1973), lime sealing (Kumar *et al.*, 1969) and storage at controlled temperature and humidity (Card and Nesheim, 1973; Orr and Fletcher, 1973). Most of the materials used for such preservation may be unavailable in Nigeria or too expensive for the ordinary farmer. In Nigeria, however some traditional methods have been used in preserving egg quality. The effectiveness of these methods has not been tested. In addition, there are some other cheap methods which might be effective in preserving egg quality but have not been tested in relation to Nigeria.

This report was designed to study the effects of traditional and other methods of storage on preservation of the quality of shell eggs.

MATERIALS AND METHODS

Chicken eggs used for these studies were obtained from the College poultry farm and were initially clean fresh eggs laid within eight hours of collection. The birds used were crossbred (Rhode Island Red and White Leghorn) hens raised in battery cages. The hens were fed, *ad libitum*, a prepared layers' ration with the

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following composition (in percent); maize 60.25; groundnut meal 18.5; wheat bran 10; oyster meal 6; bone meal 2.5; palm oil 2.0; salt 0.25; Pfizer vitamin-mineral premix 0.5. The ration was formulated to contain 15% protein, 2850 kilocalorie per kilogram metabolizable energy, 3% calcium and 0.70% phosphorus. As soon as the eggs were collected, they were sized in an egg grader ('EISO' 1600)¹ and only those eggs that fell within the large size range (range of 54 to 60 gram and average of 56 grams) were used for the studies. The selected eggs were individually numbered, weighed and then divided into groups such that each group contained equal numbers of eggs and had the same weight distribution and average weight. One group of eggs (fresh eggs) was used to obtain the initial data of characteristics studied in the experiments. The characteristics studied were per cent loss in weight, Haugh units, yolk index, pH of albumen and physical composition of the eggs. The methods used for determining these characteristics have already been described (Olomu, 1975). Using the above characteristics, three experiments, each lasting four weeks, were designed to study the effects of different methods of storage on the quality of eggs. In choosing the storage methods, an initial survey was carried out to determine those traditional methods of storage which were in use for preserving eggs in Nigeria. In addition, some methods which have been tried and reported in the literature were also tested. The storage methods used are as described below:

Water treatment

Each egg was immersed in warm water (55°C, according to Card and Nesheim, 1973) or cold water (25.5°C) for 1 minute,

lifted from water and then allowed to drain for ten seconds. The eggs were then transferred to filler flats and stored at room temperature for 4 weeks.

Oil treatment

The oils, groundnut oil (25°C) and palm oil (25°C) used for the experiments were liquid and free flowing and were employed in the experiments on the day of purchase from the local market. Each egg was immersed in palm oil or groundnut oil, lifted from the oil, allowed to drain for ten seconds and then transferred to filler flats and stored at room temperature (Experiment 1) or at room temperature and refrigerator (Experiments 2 and 3 respectively) for 4 weeks. In Experiments 1 and 2, one minute treatment was used while in Experiment 3, 1 and 5 minutes treatments were compared.

Starch treatment

One hundred grams of starch purchased from the local market were dissolved in water and the suspension made up to 500 ml. Each egg was then immersed in this solution for one minute, and stored as with water treatment.

Untreated eggs

One group of eggs was stored in filler flats either in the refrigerator or at room temperature for 4 weeks, to serve as the controls.

The treatments used and the characters studied in Experiments 1 and 2 are shown in Tables 1 and 2 and those used in Experiment 3 are shown in Table 3 and 4. In Experiments 1 and 2, eight eggs were used per treatment group while in Experiment 3, twelve eggs were used per treatment group.

¹ EB Equipment, Redbrook, Barnsley.

During the experimental periods, the temperature and relative humidity of the storage environments were recorded every day. All data obtained in the experiments were subjected to analysis of variance and significance of differences were assessed by applying Duncan's Multiple Range Test at the 1% level of probability (Steel and Torrie, 1960).

RESULTS

Experiment 1

Results obtained in Experiment 1 are summarised in Table 1. Eggs stored by immersion in cold water for 4 weeks developed off-odours and were difficult to open without rupturing the yolk. They were thus eliminated from the analyses. Eggs treated with warm water, cold water, starch or stored at room temperature had significantly higher percent weight loss, lower Haugh unit and yolk index values than fresh eggs or those treated with groundnut oil, palm oil and those stored in the refrigerator. The percent weight losses of eggs treated with groundnut oil and palm oil were significantly less than those of eggs stored in the refrigerator. The pH values of eggs treated with groundnut oil or palm oil

were significantly lower than those of fresh eggs or any other eggs used in the experiment, while the pH values of eggs treated with starch, cold water, warm water or stored at room temperature or refrigerator were significantly higher than those of fresh eggs.

Experiment 2

Since Experiment 1 indicated that groundnut oil and palm oil were effective in enhancing the keeping quality of eggs, these two agents were further evaluated in a second experiment (Table 2). As in Experiment 1, per cent weight loss was least for eggs treated with oil before storage and highest for eggs stored untreated at room temperature. It was also observed that oil treatment resulted in the retention of a high proportion of the original Haugh unit and yolk index values of the eggs, a proportion similar to those of eggs stored untreated in the refrigerator but significantly higher than those of eggs stored untreated at room temperature. Refrigerated storage of the oil-treated eggs resulted in only a slight improvement in the Haugh unit and yolk index values and apparently had no effect on percent weight loss and pH values. As in Experi-

TABLE 1

Effects of Different Treatments on Percent weight loss (WL), Haugh unit (HU), Yolk index [YI] and pH of albumen of Eggs¹

Treatment	WL	HU	YI	pH
Fresh eggs	0.00a	82.55a	0.47a	8.26b
Groundnut oil	0.59b	79.84a	0.38b	7.79a
Palm oil	0.86b	81.42a	0.39b	7.74a
Warm water	6.19d	70.15b	0.15c	9.19cd
Cold water	5.87d	70.31b	0.14c	9.14cd
Starch	5.76d	68.20b	0.17b	9.20cd
Refrigerated ²	1.97c	82.06a	0.40d	9.08c
Room temperature ³	6.72d	65.62b	0.13c	9.24d

¹ Column values with same superscript are not significantly different ($P < 0.01$).

² Refrigerated temperature = 3.5°C

³ Room temperature = 25.2°C; Relative humidity = 61.7%.

TABLE 2

Weight loss, Haugh Units, Yolk index and pH of Albumen of Oil-treated Eggs stored at Room temperature or in the Refrigerator¹

Treatment	WL	HU	YI	pH
Fresh eggs	0.00a	87.35a	0.46a	8.29b
Palm oil — RT ²	0.72c	76.99bc	0.39a	8.01ab
Palm oil — Refr. ³	0.70c	78.83ab	0.43a	7.80a
Groundnut oil — RT	0.20b	80.30ab	0.39a	7.69a
Groundnut oil — Refri.	0.21b	85.82ab	0.43a	7.90a
Refrigerated	2.05d	81.34ab	0.39a	8.80c
Room Temperature	4.99b	68.05c	0.14b	9.22d

¹ Column values with same superscript are not significantly different ($P < 0.01$).

² RT = Room temperature = 25.20°C.

³ Refr. = Refrigerated temperature = 3.50°C.

TABLE 3

Weight loss, Haugh units, Yolk index and pH of albumen of Eggs as affected by length of treatment with Groundnut oil¹

Treatment	WL	HU	YI	pH
Fresh eggs	0.00a	83.74a	0.42a	8.14c
Groundnut oil — 5 minutes — RT ²	0.53b	79.62a	0.39b	7.55d
Groundnut oil — 5 minutes — Refri. ³	0.52b	82.12a	0.43a	7.54d
Groundnut oil — 1 minute — RT	0.48b	76.11a	0.38b	7.66d
Groundnut oil — 1 minute — Refr.	0.49b	81.38a	0.43a	7.66d
Refrigerated	1.96c	78.95a	0.43a	8.35b
Room temperature	4.98d	67.17b	0.20c	8.64a

¹ Column values with same superscript are not significantly different ($P < 0.01$).

² RT = Room temperature = 25.20°C.

³ Refri. = Refrigerated temperature = 3.50°C.

ment 1, the pH values of oil-treated eggs were significantly depressed below those of fresh eggs and eggs stored untreated at room temperature or in the refrigerator.

Experiment 3

Eggs treated with palm oil were yellow in colour, sticky to touch and were not readily acceptable when presented to consumers. On the contrary, eggs treated with groundnut oil were transparent, glossy, smooth and were indistinguishable from fresh eggs. The groundnut oil-treated eggs were readily accepted by consumers. Groundnut oil was thus taken as the agent of choice and further evaluated in terms of length of treatment in Experiment 3 (Table 3). Eggs treated

with groundnut oil for one or five minutes had similar percent weight loss, Haugh unit, yolk index and pH values. Thus one minute treatment was as effective as five minutes treatment. As in Experiments 1 and 2, the pH of the albumen of groundnut oil-treated eggs was significantly lower than that of other eggs employed in the experiment. As also observed in Experiment 2, refrigerated storage of the groundnut oil-treated eggs resulted in only a slight improvement in the Haugh unit and yolk index values but had no effect on percent weight loss and pH values of the eggs. The lowest Haugh unit and yolk index values and highest percent weight loss and albumen pH were recorded for eggs stored untreated at room temperature

The effects of treatment on the physical composition of eggs are shown in Table 4. The percent shell content did not show any definite pattern. Eggs stored untreated

at room temperature had percentage yolk content significantly higher than, and albumen content significantly lower than, those of fresh eggs, although not

TABLE 4
Physical Composition of Eggs as affected by length of treatment with Groundnut oil ¹

Treatment	Shell (%)	Yolk (%)	Albumen (%)
Fresh eggs	11.13b	31.74a	57.13a
Groundnut oil — 5 minutes — RT ²	11.18b	35.69ab	53.13ab
Groundnut oil — 5 minutes — Refri. ³	10.79c	33.19ab	56.02ab
Groundnut oil — 1 minute — RT	11.19b	35.65ab	53.31ab
Groundnut oil — 1 minute — Refri.	11.32ab	33.73ab	55.31ab
Refrigerated	11.96a	33.20ab	54.84ab
Room temperature	10.98b	36.59b	52.44b

¹ Column value with same superscripts are not significantly different ($P < 0.01$).

² RT = Room temperature = 25.20°C.

³ Refri. = Refrigerated temperature = 3.50°C.

significantly different from those of refrigerated and oil-treated eggs. The percentage yolk and albumen contents of oil-treated and refrigerated eggs were similar and were not significantly different from those of fresh eggs.

DISCUSSION

In a previous report (Olomu, 1975), it was noted that eggs stored for four weeks at room temperature without treatment deteriorated in quality. The present results confirm that previous finding. The observation that storage by immersion in water led to development of off-odours and weakening of the vitelline membrane of the yolk and hence rupturing of the yolk suggests that such method of storage should be discouraged in Nigeria.

The present studies also indicate that of all the methods tested for storing eggs, only treatment of eggs with palm oil or groundnut oil before storage for 4 weeks

at room temperature resulted in the retention of a high proportion of the original Haugh units, yolk indices and weights of eggs, a proportion very similar to that of eggs stored in the refrigerator and higher than that of eggs stored untreated at room temperature. The results also showed that the value of oil-treated eggs may be enhanced slightly by storing the oil-treated eggs in the refrigerator. The beneficial effects of oil-treatment may be due to the capacity of the oils to seal the pores present on the egg shell surface by the deposition of a thin film of oil, a proposition that may also serve to explain the reduced weight loss recorded on the eggs treated with palm oil or groundnut oil. These observations are in agreement with those of Kumar *et al* (1969) although the earlier workers used a commercially prepared egg coating oil as compared to natural edible oils used in the present studies. The deterioration in Haugh unit and yolk index values of untreated eggs

stored at room temperature is in agreement with previous findings (Olomu, 1975).

The maintenance of comparatively low pH values when eggs were oil treated may be related to the sealing of the pores present in the egg shell surface thus preventing the loss of carbon dioxide, water and various gases from inside the egg. Low pH values (7.4-8.4) are normal for good quality eggs. (Olomu, unpublished data)

The significant increase in the percentage of yolk and decrease in percentage of albumen of eggs stored at room temperature agree with similar findings in a previous report (Olomu, 1975) and may be associated with the transfer of water from albumen to yolk.

The above results thus indicate that in areas of Nigeria where cold storage facilities are not readily available, treatment of eggs with oil for one minute may aid in storage of eggs for at least 4 weeks. Where cold storage facilities are available, treatment with oil, especially groundnut oil, before storage may further enhance the keeping quality of eggs. Groundnut oil is readily available. A normal bottle of groundnut oil which contains between 600 and 700 grams and costs about 60

or 70 kobo has been successfully used to treat over one hundred dozen eggs with an average groundnut oil coating of 0.05 gram.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. E. D. Spiff and Dr. U. W. U. Ayonoadu for providing research facilities and for their keen interest during the course of the investigation. Technical assistance provided by Miss A. Mba is gratefully acknowledged.

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