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# PREPARATION OF MODERN EGG SHELL FOR USE IN COMPARATIVE STUDIES OF ARCHAEOLOGICAL SAMPLES

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# THE PREPARATION OF MODERN EGG-SHELL FOR USE IN COMPARATIVE STUDIES OF ARCHAEOLOGICAL SAMPLES.

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## Introduction

In order to identify archaeological egg-shell it is first necessary to study a range of features for different species using known modern material. The structure of an "unknown" may then be compared with this body of data in order to produce a probable identification. Direct comparison of modern and archaeological egg-shell is complicated by degradation of the ancient samples. The aim of the work described below was to identify a preparation method which would produce modern reference material easily comparable to archaeological samples.

In fresh material the organic membranes and cuticle/cover mask the underlying crystalline structures and therefore it is often necessary to remove these in studies on egg-shell. (Incidentally, removal of this component produces material more closely resembling archaeological specimens, in which the organic portion rarely survives).

Methods previously used include:-

1. Tullet (1975). The shell is boiled for 5 mins in 5% (w/v) NaOH before rinsing in hot running water and leaving to dry at room temperature. It is claimed that this method removes most organic material, although it may not dissolve the pore plugs.

2. Simons (1971) mentions several methods, including boiling in 10% KOH to partly remove the cuticle, etching or polished fractures by boiling in 10% $Na_2S$ for 10 mins, and removal of the outer cuticle by treatment with 5% EDTA for one hour (pH 7.2) and then spraying with a water jet.

3. Heyn (1963) suggests boiling for 10 mins in 10% $Na_2S$, or leaving in this solution at a lower temperature for a longer period of time in order to remove most of the organic matrix. He states that $Na_2S$ is the best solvent for ovokeratin. He also mentions boiling for 10 mins in 5% KOH.

4. Tyler (1956) made plastic models of the pore system to simplify counting, shape observations etc.

It was decided to test 2 of these methods (NaOH and $Na_2S$).

Method

The eggs used were modern specimens of domestic fowl (unhatched), duck (unhatched) and turkey (hatched). All of these had been kept in the collection for some time previously. Pieces about 1 cm square were removed from the shoulder-to-waist region (*ie.* not from either pole or the central waist region). These were soaked in distilled water and the inner membrane stripped away with forceps. A sample from each specimen was then treated in one of 4 ways:-

1. Boiled in 5% NaOH for 5 mins.

2. Boiled in 5% NaOH for 10 mins.

3. Boiled in 10% $Na_2S$ for 10 mins.

4. Soaked in 10% $Na_2S$ overnight.

They were then washed thoroughly in hot running water and left to dry in air. The physical appearance of each sample was noted both before and after treatment.

The dry samples were fractured and mounted on brass stubs so that both inner and outer surfaces and a fractured cross-section were visible. They were then vacuum coated with gold palladium and viewed in a Jeol JSM-S1 scanning electron microscope at 4 kv and magnifications between 70 and 2,000 times.

## Results

The observed results are summarised in Table I.

## Conclusions

The clearest difference between the methods tested was in the efficiency of outer membrane removal. The sodium hydroxide treatment was clearly more effective than sodium sulphide. Soaking in cold $Na_2S$ had little effect. (The membrane was missing from all of the turkey samples because of the changes associated with hatching (Simons, 1971)).

Otherwise, little variation was observed with different preparation methods. No erosion of the "mammillae" was noted in any of the hen or duck samples. There was partial resorption in the turkey due to hatching

(Simons 1971). Boiling in NaOH may have produced a little additional erosion in this case. Heyn (1963) suggests that erosion of calcite may occur in alkali.

It was decided to use boiling in 5% NaOH for 10 mins as a standard preparation method for modern material (despite the risk of causing slight erosion) because of the effective membrane removal. The time can be reduced if erosion should be noted in a particular case.

The resulting material will not be directly comparable to archaeological specimens since the condition of these is variable. Hopefully, however, sufficient information will be obtained to allow comparison after interpretation of observed structures.

References

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Tullett, S.G., 1975. Regulation of avian egg shell porosity. J. Zoology 177 339-348.

Tyler, C, 1965. Studies on Eggshells VII - Some aspects of structure as shown by plastic models. J. Sci. Food Agric. 7 483-493.

| | TABLE I | 5% NaOH (5 mins) | 5% NaOH (10 mins) | 10% $Na_2S$ (10 mins) | 10% $Na_2S$ (overnight) |
|---|---|---|---|---|---|
| FOWL UNHATCHED | Outer membrane | Slight remains | Traces (on tips of mammillae) | c 50% remaining. Some individual fibres. Many disorganised. | c 75% remaining. Individual fibres visible. |
| | "Mammillae" | Uneroded | Uneroded | Uneroded | Uneroded |
| | Cuticle/cover | Present, cracked around pores | Present, cracked around pores | Present, cracked across pores | Present, cracked across pores |
| | Pores | Appear as cracked areas, dark in electron beam | Some unblocked, some as cracked areas | Usually appear as a depression traversed by a crack | Usually appear as a depression traversed by a crack |
| | Sem stub no | 71 | 100 | 101 | 102 |
| | Negative Nos | SEM 73: 18-20 | SEM 34: 20 SEM 36: 10-12<br>SEM 35: 3 SEM 73: 21, 22<br>SEM 74: 1 | SEM 34: 14, 15, 19<br>SEM 74: 2-4 | SEM 35: 4-7<br>SEM 74: 5-7 |
| DUCK UNHATCHED | Outer membrane | Discontinuous layer on tips of most mammillae | Discontinuous layer on tips of most mammillae | Thin, almost continuous layer | Almost intact |
| | "Mammillae" | Uneroded | Uneroded | Shape visible under membrane layer | Only just visible beneath remains of membrane |
| | Cuticle/cover | Outer surface minutely pitted | Outer surface minutely pitted | Outer surface minutely pitted | Outer surface minutely pitted |
| | Pores | Some open, others appear as a depression traversed by crack(s) | Some open | Some open | Some open, others appear as a depression traversed by crack(s) |
| | Sem stub no | 103 | 104 | 105 | 106 |
| | Negative Nos | SEM 35: 8-11<br>SEM 74: 8-10 | SEM 36: 3-5<br>SEM 75: 3-5 | SEM 34: 16-18<br>SEM 75: 6-8 | SEM 36: 6-9<br>SEM 75: 9-11 |

| | TABLE I | 5% NaOH (5 mins) | 5% NaOH (10 mins) | 10% $Na_2S$ (10 mins) | 10% $Na_2S$ (overnight) |
|---|---|---|---|---|---|
| TURKEY HATCHED | Outer Membrane | Absent | Absent | Absent | Absent |
| | "Mammillae" | Eroded | Eroded | Eroded | Eroded |
| | Cuticle/Cover | Outer surface cracked over pores | Outer surface cracked over pores | Outer surface cracked over pores | Some areas with smooth, badly cracked, outer surface |
| | Pores | Some open, others indicated by cracking of surface | Some open, others indicated by cracking of surface | Some open, some filled with debris, some visible as cracked areas | Some open, some visible as cracked areas. Some appear dark in electron beam |
| | Sem stub no | 107 | 108 | 109 | 110 |
| | Negative Nos | SEM 34: 1-4<br>SEM 75: 12-14 | SEM 34: 5-8<br>SEM 75: 15-17 | SEM 34: 9-12, 16<br>SEM 75: 18-20 | SEM 34: 13, 20-23 |