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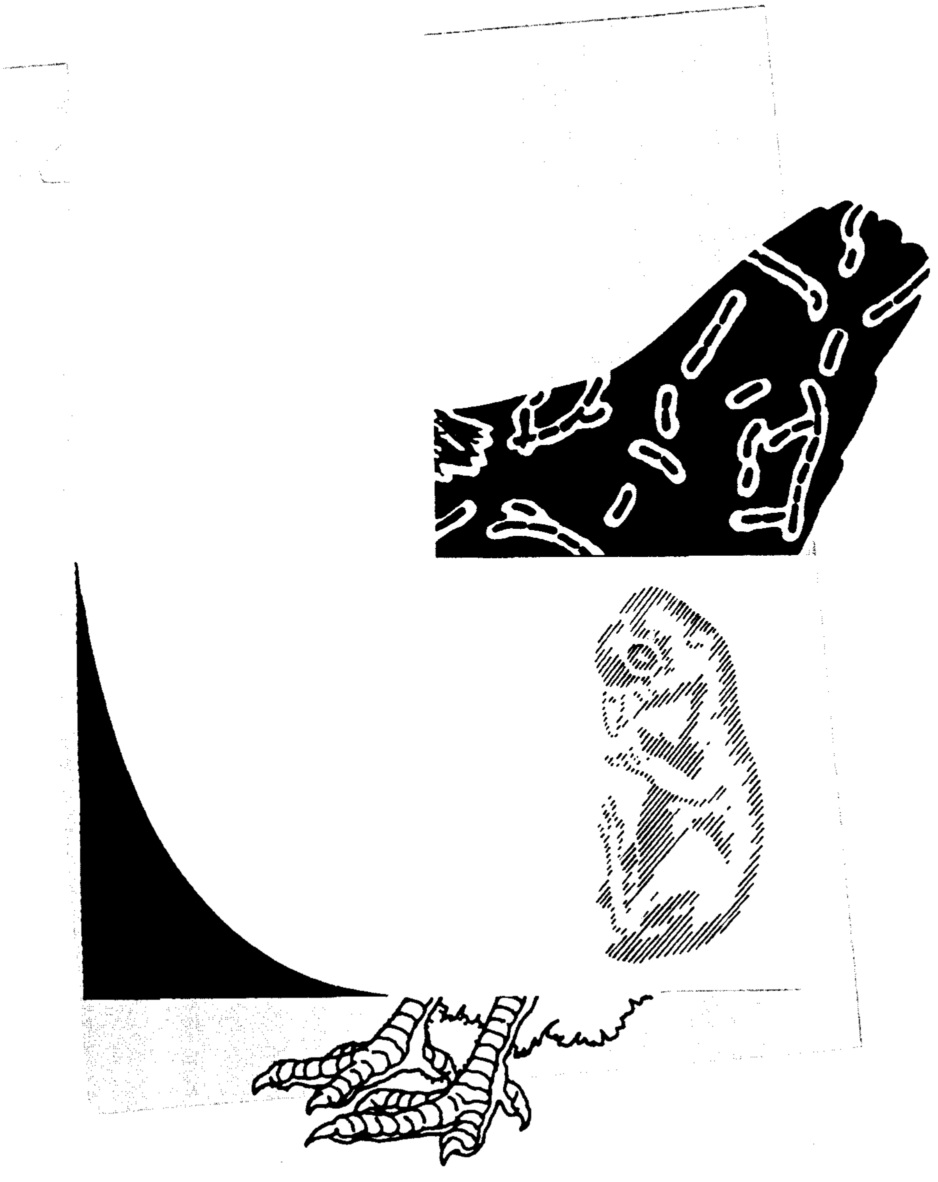

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Effect of egg weight categories, storage time and storage temperature on incubation length in Pekin duck eggs (*Anas platyrhynchos* L.)

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Synchronisation of embryos during incubation is of fundamental importance to obtain good hatches. The primary factor that affects incubation time is the type of setter used with its temperature but incubation time depends also on age and size of the eggs and on temperature of the storage room (Lundy, 1969; Bagliacca *et al.*, 2003).

For these reasons the incubation length of Pekin duck eggs was studied, according to a factorial experimental design, in relationship to storage time (3, 7 and 14 days), storage temperature (18 ± 1°C and 15 ± 1°C) and egg size (72.2–77.4-g, 77.5–82.8-g, 82.9–88.1-g and 88.2–93.5-g; *i.e.* these categories represent the average egg weight −2*SD, −1*SD, +1*SD, and +2*SD respectively). The experiment involved collection of 1,206 eggs over a period of 2 days. Before storage the eggs laid were gathered, placed on metallic egg flats with their small ends down, washed and fumigated. During storage all eggs were daily turned ±60° and relative humidity was maintained at 70 ± 5%. Incubation was carried out in a commercial multi-stage incubator (99.7°F dry and 82–84°F wet bulb) and the eggs were daily sprayed from the 10th to the 23th day according to the incubation technology of duck eggs (Bagliacca *et al.*, 1991).

Table 1 Pekin duck incubation length, response in relationship to temperature × storage-length+egg weight categories

		Interaction: temperature × Storage length			Main effect temperature
		3 days	7 days	14 days	
15°C	Number	172	136	92	400
	Least SM (days)	27.92[d]	28.11[c]	28.31[a]	28.11[a]
	SE	0.009	0.010	0.013	0.006
18°C	Number	176	134	94	404
	Least SM (days)	27.89[d]	28.08[c]	28.25[b]	28.08[b]
	SE	0.009	0.011	0.013	0.006
Main Effect Storage	Number	348	270	186	
	Least SM (days)	27.91[c]	28.09[b]	28.28[a]	
	SE	0.007	0.007	0.009	

Means with different letters differ per $P < 0.05$.

Abstracts listed in alphabetical order of first author. *Indicates presenter.

Table 2 Relationships between egg weight categories and length of incubation period

Egg weight categories (g)	72.2–77.4	77.5–82.8	82.9–88.1	88.2–95.4
Number	134	240	326	104
Least SM (days)	27.89[c]	28.02[b]	28.11[ab]	28.18[a]
SE	0.015	0.011	0.009	0.017

Means with different letters differ per $P < 0.05$.

Results showed that storage from 3, through 7, to 14 days, significantly prolonged the incubation time (Table 1). The average total incubation time was described by the following linear and polynomial relationships (Hatch-time- $= 27.82 + 0.0343 \times \text{Storage}$, R^2-adj $= 0.581$; Hatch-time $= 27.81 + 0.0403 \times \text{Storage} + 0.0019$ (storage-6.8878)^{2}, $R^2 -$ adj $= 0.597$). The size of the eggs also significantly influenced the incubation time (Table 2).

Since optimum hatchability and duckling quality can only be achieved when chicks hatch contemporaneously, in commercial duck hatcheries a "setting time correction" is needed to reduce the spread of hatch. If the eggs are incubated once a week, the most widespread storage time, the correction for the storage length is −4h:33′ for 3 days of storage. For lighter and heavier eggs the corrections are −3h:11′ and +3h:42′ respectively. This means that fresh and stored eggs, and lighter and heavier eggs, need to be set at different times.

Bagliacca, M., Paci, G. and Marzoni, M. 2003. Effect of egg weight categories, storage time and storage temperature on incubation length in Muscovy duck eggs (*Cairina moschata L.*) *2nd World Waterfowl Conference, Alexandria Egypt (Oct 7–9).*

Bagliacca, M., Paci, G., Marzoni, M. and Avanzi, C. F. 1991. Tecnologia di incubazione delle uova degli anatidi – Incubation technology of duck egg. III *Convegno CNR Gruppo Allevamenti delle piccole Specie, Roma. Edizioni Fondazione Iniziative Zoprofilattiche e Zotecniche*, **31**, 95–107.

Lundy, H. 1969. A review of the effects of temperature, humidity, turning and gaseous environment in the incubator on the hatchability of the hen's egg. In: *Fertility and Hatchability of the Hen's Egg*. T. C. Carter and B. M. Freeman (eds), pp. 143–176. Oliver & Boyd, Edinburgh.

Bacterial degradation of eggshell cuticle of the Mandarin duck (*Aix galericulata*)

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The Mandarin duck is a cavity nester in the UK (Davis and Baggott, 1989). Females incubate clutches of up to 30 eggs for about 33 days. During natural incubation G_{H_2O} can increase by about 70% in the first 7 days of incubation (Baggott and Graeme-Cook, 1997). The initial G_{H_2O} is low, for egg weight, due to cuticle completely covering pore apertures. During the first week of natural incubation counts of surface bacteria capable of culture at incubation temperature decrease but the proportion of *Bacillus licheniformis* increases (Baggott and Graeme-Cook, 2002). As this species has the capability to digest duck cuticle (Baggott and Graeme-Cook, 2002), it is hypothesised that it may be responsible for the increase in G_{H_2O} in the first week of incubation. The objective of this study was to identify what cuticle proteins, if any, were capable of degradation by *B. licheniformis* cultured from the Mandarin eggshell surface.

Using SDS-polyacrylamide gel electrophoresis (PAGE), one major protein was identified in the cuticle of unincubated eggs of Mandarin duck that was not detectable in the shell matrix. This protein had a molecular weight of 30 kDa as estimated using molecular weight standards and did not react with Schiff's reagent indicating that it was not a glycoprotein. Eight additional protein bands, found in the cuticular sample were also present in the shell matrix fraction. These had approximate molecular weights of >80 kDa (×2), 79 kDa, 71 kDa, 60 kDa, 40 kDa, 15 kDa, 12 kDa and all stained with Schiff's reagent suggesting that they contain carbohydrate moieties. In the Pekin duck, matrix proteins of 15k (lysozyme), 17k, 32k, 66k and 78 kDa (ovotransferrin) have been identified (Panheleux *et al.*, 1999); as in this species, a 45 kDa matrix protein (ovalbumin) was absent from Mandarin profiles. Analysis of proteins in the cuticle of commercial duck consumption eggs also showed the presence of a protein exclusive to the cuticle but in this case it had an apparent molecular weight of 40 kDa.