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STUDY OF THE MAJOR ELEMENTAL CONSTITUENTS AND ULTRASTRUCTURE OF AVIAN EGGSHELL ADOPTING LASER AND SEM TECHNIQUES

By

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Thesis

Submitted in partial fulfillment of
the requirements for the degree of
Master of Laser Science

**Department of Environmental, Photochemical & Agricultural Applications
National Institute of Laser Enhanced Sciences (NILES)
Cairo University**

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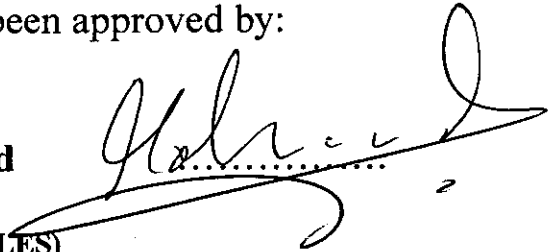
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EGGSHELL ADOPTING LASER AND SEM
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ABSTRACT

The avian eggshell is composite structure of calcium carbonate in association with organic components. Calcium, magnesium, and sodium are major inorganic constituents of the avian eggshell. However, Ca distribution is not homogenous throughout the shell thickness, its relative concentration increases from inside to outside. This phenomenon is more pronounced after hatching indicating the consumption of the inner layer contents by the embryo during its development. On the other hand Mg and Na concentrations in the internal layers of the eggshell before hatching are higher than after hatching for the same reasoning. It has been suggested that an increase in magnesium content of the shell is directly related to an increase in shell hardness. In the present work Laser Induced Breakdown Spectroscopy (LIBS) technique has been used to study the avian eggshell elemental composition before and after hatching. Depth profiling of the shell is also carried out to follow-up different elements throughout the shell thickness using the same laser spectroscopic technique. The evaluation of the LIBS spectra of the examined samples provided us with qualitative information about the consumption of different elements during incubation. Scanning electron microscopy was also used to assess the relationship between layers of the eggshell before and after hatching. The thicknesses of the mammillary, palisade, vertical crystal, and cuticle layers relative to the total eggshell thickness were measured before and after hatching. The percent contribution of the layers was different in the thinnest and thickest eggshell after and before hatching respectively. To confirm the previous results concerning the distribution of calcium through the shell thickness energy Dispersive X-ray Spectroscopy (EDS) has been used. In addition preliminary

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results have been obtained in a study of the effect of laser exposure of avian eggs prior incubation on the hatchability.

The milestone of the present thesis is to explore the possibility of harnessing new technological tools such as LIBS in poultry science. Of great interest is performing in *situ* studies in incubation centers for quality control and improvement of the productivity.

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