

Eggshell organic matrix spatial distribution and eggshell microstructure: A Raman and infrared microscopy study.

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The avian eggshell is bioceramic composite made of a mineral part (>95 % CaCO₃ in the form of calcite) and a minority organic matrix of very complex composition (1 - 3.5 %; Hincke et al., 2012). The microstructure and composition of eggshell varies across its thickness. The mineral part of the hen eggshell is about 350 µm thick and consists of columnar calcite crystals or palisades that nucleate from organic structures known as mammillary knobs rich in keratan sulfate proteoglycans. The mammillary knobs are pseudo-periodically arranged on the inner fibrous eggshell membranes made of cross-linked collagen fibres. Finally, the outermost surface of the eggshell is a thin vertical calcite crystal layer coated by an organic rich layer or cuticle composed of glycoproteins, lipids, polysaccharides and pigments. In this study we have analyzed in detail the chemical composition the eggshell cuticle and eggshell organic matrix and its relationship with eggshell structure using Raman microscopy and infrared spectroscopic techniques. These analytical techniques allow determining the spatial distribution of molecular groups associated to main components of the eggshell organic matrix in relation to different eggshell structural parts. The results obtained confirm the high degree of specialization of organic eggshell matrix components regulating eggshell mineralization at different stages of eggshell formation and are in agreement with previous works based on very complex histochemical and immuno labelling techniques (Fernandez et al., 2001).

References

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