

The avian eggshell extracellular matrix as a model for biomineralization

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The avian eggshell is a complex, extracellularly assembled structure which contains both mineralized and non-mineralized regions. The composition of the hen eggshell organic matrix was examined by immunohistochemistry with antibodies to different extracellular matrix molecules. Type I collagen is found in the shell membranes, but only after treatment of the tissue sections with pepsin. When incomplete eggshells are removed from the oviduct and immunostained, type I collagen can be detected in the shell membranes without pepsin treatment. The shell membranes, which are non-mineralized, also contain type X collagen, and this immunostaining does not require pepsin treatment. The occurrence of type X collagen in the shell membranes is surprising, since this collagen has not been found in any tissue other than hypertrophic cartilage. Immunostaining for various glycosaminoglycans shows the presence of keratan sulfate and dermatan sulfate. Several different antibodies to keratan sulfate stain