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会议专栏

# 不溶性基质中天冬氨酸丰富的蛋白在珊瑚的钙质骨片形成中的重要作用

M. Azizur Rahman, and Tamotsu Oomori

Department of Chemistry, University of the Ryukyus, 1 Senbaru, Nishihara-cho, Okinawa, Japan

**摘　要:** 一般认为，酸性蛋白在控制矿物的形成和发展中发挥重要作用。因此，在不溶性有机基质中鉴定酸性蛋白对于理解珊瑚中个体蛋白的功能是非常重要的一步。在短指多型软珊瑚(Sinularia polydactyla)的可溶性和不溶性基质层中分析蛋白组分表明，在不溶性基质和可溶性基质层中天冬氨酸的含量分别是 61%和 29%。利用体外分析法发现，基质蛋白诱导碳酸钙形成非晶态析出相先于其形成钙质的结晶态。利用 X-射线衍射来鉴定骨片上结晶态的碳酸钙，结果表明钙质的多晶态呈现强反射。傅利叶变换红外光谱分析表明珊瑚基质中富含天冬氨酸的蛋白和多醣的结构。在不溶性基质组分中用钙离子结合分析显示一个分子量为 109 kD 的蛋白质可以与形成骨片的钙离子结合，这一过程对骨片形成非常重要。在对生物钙化过程中起重要作用的碳酸酐酶的分析中显示了此酶的新颖的活性。以上结果显示珊瑚中不溶性基质内的富含天冬氨酸的蛋白在生物矿化调控过程中起重要作用。

**关键词:** 酸性蛋白质，生物钙化，生物矿化，方解石，不溶性基质，骨片

# Aspartic Acid-rich Proteins in Insoluble Orgaic Matrix Play a Key Role in the Growth of Calcitic Sclerites in Alcyonarian Coral

M. Azizur Rahman, and Tamotsu Oomori

*Department of Chemistry, University of the Ryukyus*, 1 *Senbaru, Nishihara-cho, Okinawa, Japan*

**Abstract:** Acidic proteins are generally thought to control mineral formation and growth. Thus, characterization of acidic proteins in the insoluble organic matrix is an important first step toward linking function to individual proteins in alcyonarian coral. Analysis of proteinaceous components in the soluble and insoluble matrix fractions of *Sinularia polydactyla* indicates that aspartic acid composes about 61% of the insoluble and 29% of the soluble matrix fractions. Using an in vitro assay, we show that matrix proteins induced formation of amorphous $CaCO_3$ precipitates prior to their transformation into the calcitic crystalline form. The crystalline form of $CaCO_3$ in the sclerites was also identified by X-ray diffraction, revealing calcitic polymorphisms with a strong (104) reflection. The structure of alcyonarian organic matrices containing aspartate-rich proteins and polysaccharides was assessed by Fourier transform infrared spectroscopy (FT-IR). Calcium-binding analysis of components in the insoluble matrix fraction indicated that a protein of 109 kD can bind Ca2+, which is important for sclerite formation. An assay for carbonic anhydrase (CA) enzyme, which is thought to play an important role in the process of bio-calcification revealed novel activity. These results strongly suggest that the aspartic acid–rich proteins within the insoluble matrix of alcyonarians play a key role in biomineralization regulation.

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**Corresponding author:** M. Azizur Rahman. Tel: +81-90-44719291; E--mail: azizur31@yahoo.com; g083001@sci.u-ryukyu.ac.jp

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