Phenotypic analysis of byssus attachment strength in *Mytilus coruscus*

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BACKGROUND:

Mytilus coruscus is economically important and widely cultured in China. In recent years, mussel fall-off events regularly led to the reduction of harvest yields of suspension-cultured mussels. Mussels attach to a substrate by producing byssal threads comprising extracellular proteinaceous fibers in the dynamic marine environment. The mussel foot proteins are secreted by the mussel foot tissue, forming a solidified byssal thread in seawater. The mechanical performance of the byssal threads depends on the intermolecular crosslinking of the mussel foot proteins. The present study aims to establish an analytical method for exploring the association between the thread's toughness and the intermolecular crosslinking of the mussel foot proteins.

RESULT

1. The composition of the native byssal thread

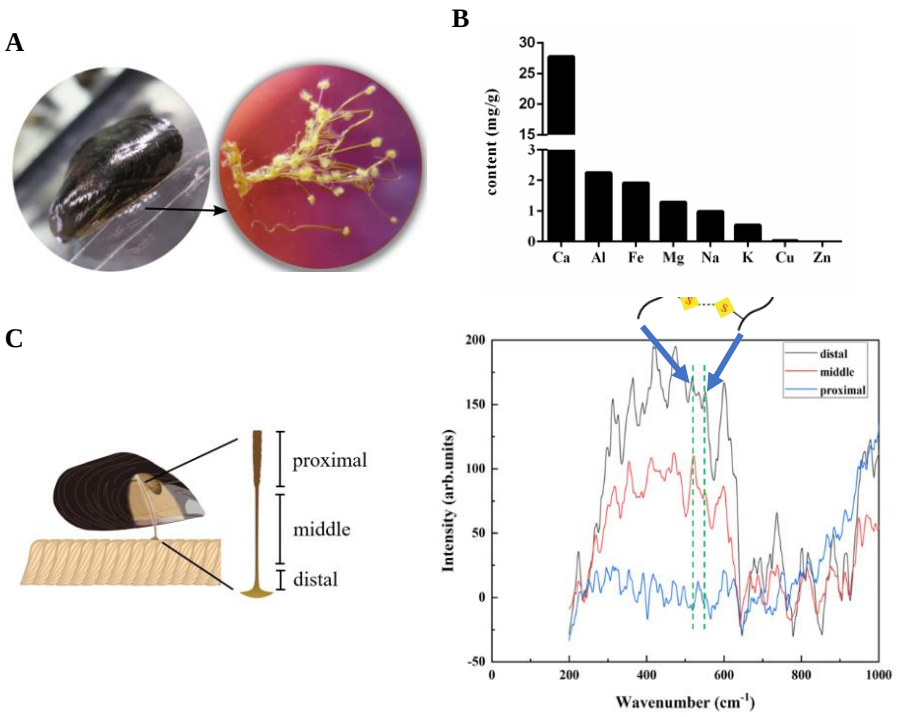

Fig. 1. The structure and toughness of the byssal threads. (A) Image of mussel byssal threads. **(B)** Quantitative analysis of metal elements in the byssal threads by ICP-MS. **(C)** Raman spectroscopic analysis of three parts of byssus.

➢ICP-MS showed the highest content of Ca element was 27.77mg/g in the byssal thread.

➢Raman spectroscopy showed that the disulfide bond content was highest at the distal of the byssus.

2. DTT and EDTA-treated reduced byssal thread toughness

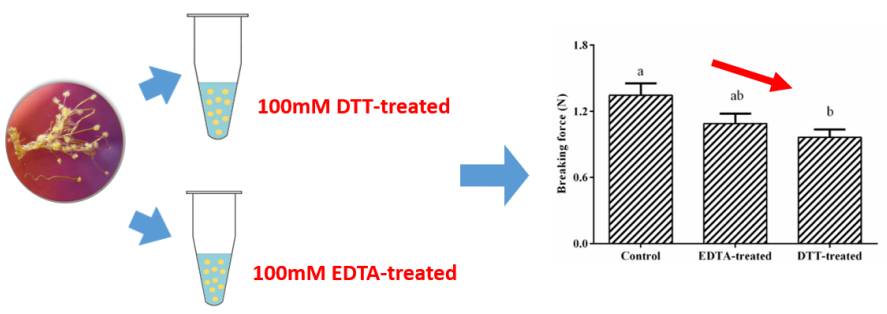

Fig. 2. The toughness of the DTT and EDTA-treated byssal thread.

3. The mechanical properties of byssus regulated by intermolecular crosslinking

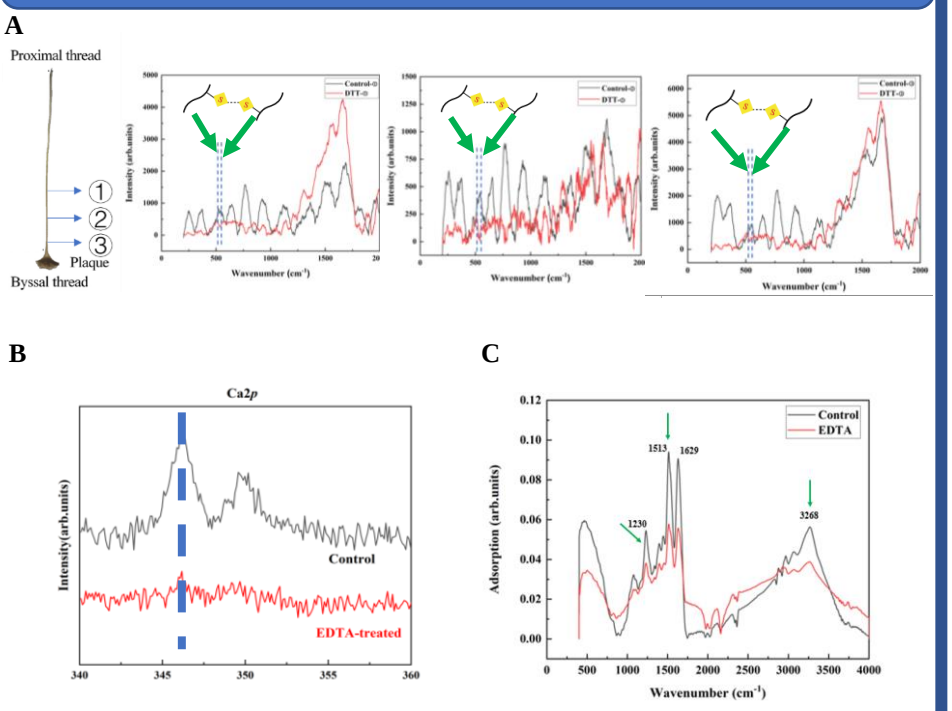

Fig. 3. The structure of EDTA and DTT-treated byssal thread. (A) Raman spectroscopic analysis of different regions. **(B)** XPS analysis of scallop byssal thread. **(C)** FTIR adsorption spectrum of control and EDTA-treated byssus.

➢Raman spectroscopy showed that the relative intensity signals of the disulfide-bond in the DTT-treated group exhibited a decrease compared to the control.

➢XPS revealed that the Ca2p signal appeared in control, but not in EDTA-treated byssus.

➢FTIR spectra revealed that the Amide region was affected in EDTA-treated byssus.

Conclusion

1. The disulfide bonds are important in maintaining the toughness of the byssus.
2. EDTA altered the protein secondary structure and decreased the toughness of the byssus.

Acknowledgement

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