Phytoliths of bamboo may cause tooth wear of Giant Panda

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Introduction

Giant panda´s (*Ailuropoda melanoleuca*) evolutionary adaptation for using bamboo as food has been demonstrated by the morphology of the teeth and by the anatomy and function of temporomandibular joint. Panda feeds both leaves and stalk of bamboo which contain particles called phytoliths. In this study we characterized phytoliths´ morphology and size, composition, and structure of two bamboo species for finding out which parts of bamboo may cause tooth wear.

Materials and methods

Two species (*Phyllostachys aureosulcata*, PA and *Phyllostachysbissetii*, PB), preferred by the panda as year-round food, were studied for inorganic content in the stalk and leaves by combustion analysis. For elemental and morphological characterization, bamboo was examined by SEM- EDS and TEM for with broad ion beam sectioning of samples or epoxy casting. For analysis of phytoliths for their crystallinity, Raman spectroscopy was used. Quartz, tridymite and cristobalite were controls. Statistical comparison between inorganic compound content was made by Wilcoxon rank sum test.

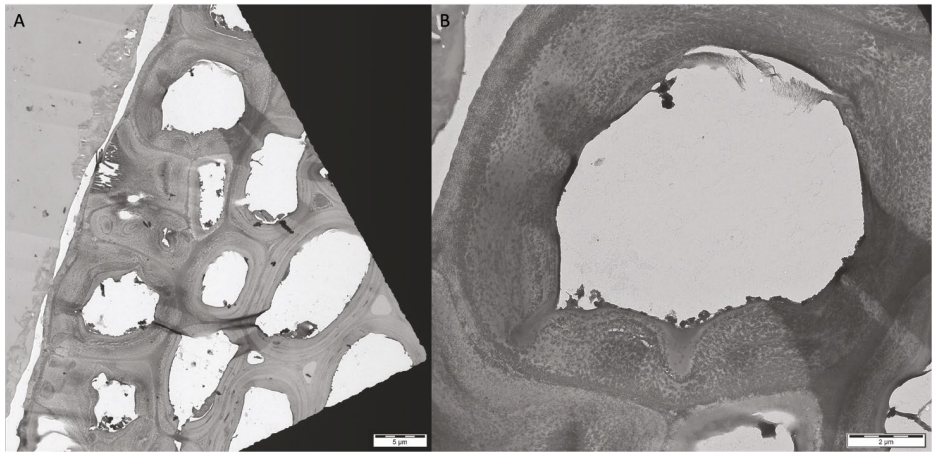

Figure 4. TEM micrograph of cross section of the green cortex of the stem of bamboo PA. On the right with original magnification 800x (bar = 5 mm) and with higher magnification (original magnification 3000x, bar = 2mm). Dark grey areas represent precipitation of nanometer scale mineral precipitation.

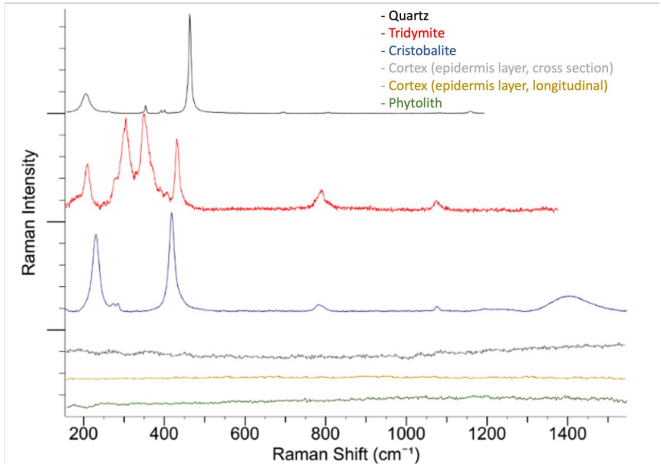

Fig. 5 RAMAN. Quartz, tridymite and Cristobalite are showing typical Raman shift for crystal structure. Gray and yellow line are showing amorphous structure of silica compound from bamboo cortex of the stalk. Green line shows amorphous structure of phytolith from leaf.

Results

Analysis showed significantly (p=0.0002) less inorganic compounds in the stalk than in leaves of both bamboo species (PA, PB). Wt-% of PB leaves was 8.0% and of cortex 1.3% and of PA 5.8% and 0.9%, respectively.

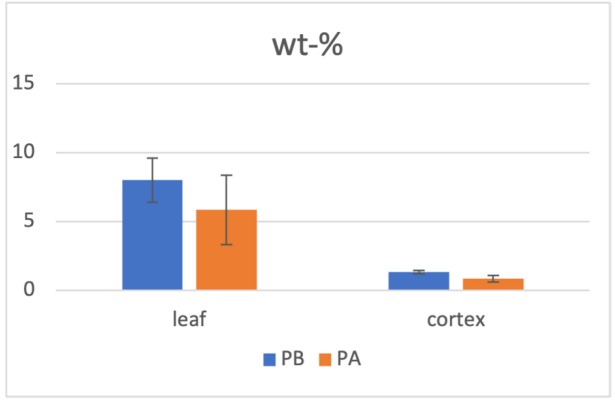

Figure 1. wt-% quantity of the inorganic compounds of leaves and cortex of stem of bamboo PA and PB.

Further it was demonstrated that phytoliths in the leaves were 30-40 um in diameter and located in upper surface with 120 um distance from each other. Phytoliths of the stalk were located on the outer cortex and they were nanometer sized. EDS showed silicon to be the major element. Raman showed amorphous structure for the silica.

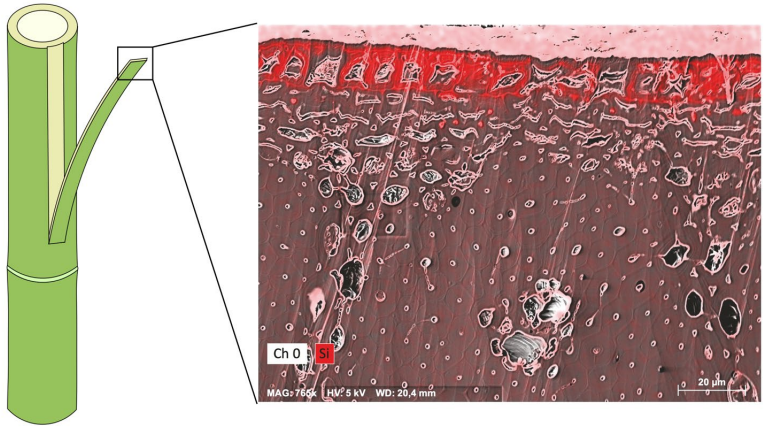

Figure 3. Schematic view of the bamboo stem and the green cortex and corresponding SEM-EDS micrograph of the cross-section showing mineral precipitation (red) on the cortex of the stem. Original magnification 765 x, bar = 20 mm.

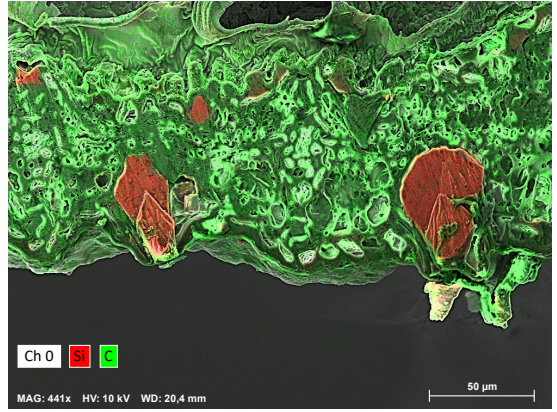

Figure 2. SEM-EDS micrograph of a leaf where phytoliths (red) are located in the upper side of the leaf. The distance between phytolith particles is 120 mm. Original magnification 441 x, bar = 50 mm)

Conclusions

This study showed that majority of phytoliths located in the leaves of bamboo and that the phytoliths were amorphous silica. PA and PB did not differ from each other. It can be expected that phytoliths may cause tooth wear of giant panda in certain parts of dentition.

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Photo of Panda: Studio art4you photography

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