Monitoring the fully reversible B to A-like DNA transformation in live bacteria cells using FTIR

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The recently demonstrated ability to detect the conformation of DNA inside cells using FTIR spectroscopy has revealed a B to A-like DNA transformation of the majority of the genomic DNA upon dehydration. Remarkably, the A-like DNA in dehydrated cells returns to native B-DNA upon rehydration[1]. However the inability of the erythrocyte and fibroblast cells used in previous work to regain functionality upon rehydration has left the biological and evolutionary importance of this observed conformational transition in doubt. Here we demonstrate the reversible B to A-like DNA transition occurring in several bacteria strains as they undergo lyophilisation and are then rehydrated. Viability counts confirm that the bacteria are alive after this process. Bands identified as diagnostic of a B to A-DNA transition including changes in band profile for both the symmetric phosphate stretch (1087 cm^{-1}) and the C-O stretch (1052 cm^{-1}), and shifts in the antisymmetric phosphate stretch (1225 – 1237 cm^{-1}) and the C-C stretch (970 – 966 cm^{-1}) were observed. With the DNA transition now demonstrated in live cells, the biological importance must be considered, particularly with regards to the previously hypothesised defence mechanism qualities inherent to A-DNA structures not only during dehydration but also with exposure to UV radiation, toxic damage and heat[2]. Previous work to identify cells and bacteria in the dehydrated state may benefit from consideration of spectra of hydrated samples in which the DNA backbone peaks are sharpened and more intense. This could potentially improve the taxonomic identification of bacteria and remove variability associated with hydration.

References

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