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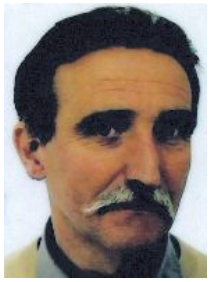
Grasping the prickly pear

A collaboration between French and Moroccan scientists has used wide angle X-ray, optical microscopy, scanning and transmission electron microscopy, and solid state ^{13}C NMR spectroscopy to reveal the detailed structure of the spines of the prickly pear, or cactus pear, *Opuntia ficus-india*.

Cactus pear, *Opuntia ficus-india* (Credit: David Bradley)

Opuntia ficus-india has been cultivated for its fruit as well as its young shoots. However, according to Michel Vignon and colleagues at the CERMAV-CNRS research centre at Joseph Fourier University in Grenoble, France and Cadi Ayyad University in Marrakech, Morocco, the spines are also revealing themselves to have potential medical benefits. Other researchers have shown that ethanol extracts of the prickly pear have analgesic and anti-inflammatory effects, while both raw and cooked extracts have been demonstrated to reduce cholesterol levels without interfering with glucose or lipoprotein levels in blood.



Michel Vignon

The spines are composed of a compact parallel arrangement of fibres made up of two polysaccharides, cellulose and arabinan. These compounds form natural composite fibres of cellulose microfibrils embedded in a matrix of arabinofuranan. This makes the spines remarkably stiff.

Aside from the application of NMR analysis, which confirms the chemical structure, the researchers were
able to confirm the detailed structure of the spine composites with X-ray diffraction. Measurements were carried out directly on the spine, on individual fibres after alkali extraction, after hydrothermal treatments, and finally after hydrolysis. The main observation is that there was no difference between the diffraction diagrams. This, the researchers suggest, shows that the cellulose system in the spines is substantially crystalline and that the microfibrils are well-aligned parallel to the spine's axis.

The results offer a unique example of an almost perfect 50:50 arabinan-cellulose natural composite, determined for the first time according to the team. "This particular association," explains Vinon, "together with the high degree of alignment is probably responsible for the very high mechanical properties of the spines."

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