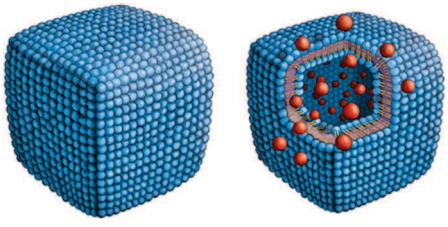
large protein movements while keeping hydrophobic residues within the bilayer. A belt of hydrophobic tryptophan residues may serve to sense the water-lipid boundary, and a trio of two tryptophans and a lysine-phospholipid interaction may serve as a pivot point for tilting.—JYLLIAN KEMSLEY

MATERIALS

Phospholipids self-assemble into cuboid vesicles

When lipids self-assemble as vesicles, they typically form spheres because that shape minimizes surface tension. Only a few nonspherical systems have been made to date, and many of those systems require templates to scaffold the structure. Now, a team led by Andreas Zumbuehl of the University of Fribourg reports a 1,2-diamidophospholipid that self-assembles into cube-shaped vesicles without a scaffold (*Angew. Chem. Int. Ed.* 2017, DOI: 10.1002/anie.201701634). Hydrogen bonding between amide groups in the lipid leads to rigid membranes. Wide-angle X-ray scattering measurements suggest that the membrane packs in a herringbone pattern, the tightest bilayer packing known. Because of their stiffness, the membranes must be heated above their melting temperature, where they are in a fluid state, to form vesicles. When the vesicles are then cooled below their melting temperature, they adopt a cubic shape that maximizes flat surfaces and minimizes edges. The researchers want to use the cubes to help design drug delivery devices that respond to mechanical triggers. "The cubes themselves are probably too frail for this purpose because of their very long defect lines along the edges," Zumbuehl says. "But they've taught us a lot about the physics needed for a next-generation mechano-responsive drug delivery container."—CELIA ARNAUD



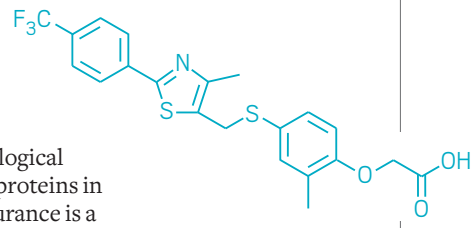
Cuboid phospholipid vesicles could be used for mechano-responsive drug delivery.

CREDIT: ANDREAS ZUMBUEHL/U. FRIBOURG (CUBE MODELS); *CHEMSUSCHEM* (SCHEME)

BIOCHEMISTRY

Chemical mimics endurance training in mice

"Hitting the wall" is a familiar experience to people who push their bodies to the limit during a marathon or even in an unexpected bout of prolonged exertion. Biochemically speaking, this means the body's tissues have used up their reserves of glucose. Exercise typically improves performance by teaching the body to oxidize fat for energy and to preserve glucose. But how that process works has remained unclear. A team of researchers led by Michael Downes and Ronald M. Evans of the Salk Institute for Biological Studies has now determined that one of the proteins in muscle that orchestrates this improved endurance is a transcription factor called PPARδ (*Cell Metab.* 2017, DOI: 10.1016/j.cmet.2017.04.006). The team also found that activating PPARδ with a compound called GW501516 enhanced endurance in mice without any training. Even "couch-potato" mice were able to run an additional 100 minutes before they hit the wall if they were given a dose of GW501516. Whether the drug-induced enhancement occurs in humans is still to be determined, but the compound has already been touted on the black market as a performance enhancer and it was banned by the World Anti-Doping Agency in 2013.—SARAH EVERTS

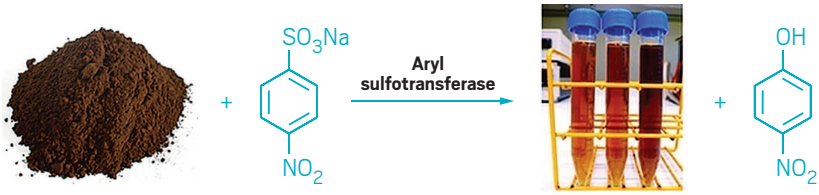


GW 501516

BIOBASED CHEMICALS

Enzymatic sulfation helps solve lignin's solubility problem

Lignin produced by plants is nature's greatest source of aromatic compounds, and it's readily available as a by-product of the pulp and paper industry. It seems natural that chemists would want to take advantage of the material as a source of aromatics to reduce reliance on coal, oil, and natural gas. One problem is that lignin's aromatics are locked up in complex insoluble polymeric chains. Gadi Rothenberg, Ron Wever, and coworkers of the University of Amsterdam have developed an enzymatic process to selectively add hydrophilic sulfate groups to lignin's many phenol rings to make the material easier to dissolve for processing (*ChemSusChem* 2017, DOI: 10.1002/cssc.201700376). Wever's group previously found that a bacterial aryl sulfotransferase enzyme can take sulfate groups from *p*-nitrophenylsulfate and add them to hydroxyl groups of various phenol compounds. The joint team has now extended the chemistry to various types of lignins. The researchers show that the process is selective for phenolic groups, leaving aliphatic hydroxyl groups in lignin side chains untouched. The resulting sulfated lignins dissolve easily in mildly alkaline solutions, with the increase in solubility visible to the naked eye and traceable by UV-Vis and NMR spectroscopy. The researchers note that the new method improves on prior lignin sulfating processes as well as current approaches that use caustic solutions, ionic liquids, or supercritical solvents, which are relatively costly and generate significant waste.—STEVE RITTER



Lignin **Sulfating agent** **Lignin dissolved in water**