pCMB at 1 mM and does not cleave the peptides at the sites of single basic residues (for example, Tyr-Gly-Gly-Phe-Met-Arg-Phe-NH_2)[3], indicating that our enzyme is not related to proteinase B. The fact that our enzyme was identified also in cell extracts prepared mechanically by Dyno-Mill treatment (not enzymatically with Zymolyase) excludes the possibility that our enzyme resulted from contamination of the Zymolyase preparation by the bacterial protease.

At present, nobody has a clear idea of how many different enzymes are involved in the processing, whether each hormone system has its own unique enzymes, or whether several generic enzymes accomplish most of the known cleavages. Therefore, identification of the enzyme candidates participating in the processing is important, and our pro-pheromone convertase Y should be compared directly with Thorner's enzyme.

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Water in the hydrocarbon core of micelles

ARE water molecules excluded from the hydrocarbon core of surfactant micelles, or can they penetrate in-between hydrocarbon chains? Dill *et al.*[1] give an answer based on the contrast variation method in neutron scattering. This method measures the zero-angle limit of the scattered intensity as a function of the scattering length density of the solvent. If their point of view is correct, it provides an important and general technique for studying the hydration and porosity of all colloidal particles. Unfortunately, their claim is based on a misinterpretation of the contrast variation method.

Indeed, for solutions of non-interacting particles, the zero-angle limit of the intensity is a purely thermodynamic quantity, related only to the mass of the dry particle, and contains no information on the arrangement of the constituents within the particle. Formally, it integrates the 'excess' scattering length density with respect to the solvent[2,3], $I(q \to 0) = AN(\Sigma b_i - \rho_s V)^2$, where A is an instrumental constant, N the number of particles, Σb_i the sum of the scattering lengths of all nuclei 'chosen' as belonging to the particle, V the corresponding volume of the particle and ρ_s the scattering length density of the solvent and q the scattering vector. If solvent molecules are included in the particle, they will contribute equally to Σb_i and to $\rho_s V$, unless their specific volume differs substantially from the bulk solvent, which would be extraordinary. Thus, their net effect on the intensity will be zero.

An equivalent formulation calculates the intensity from the 'average' scattering length density $\bar{\rho}$ of the particle; $I = AN(\bar{\rho}V - \rho_s V)^2$ with $\bar{\rho} = (\rho_p v_p + \rho_s v_s)/(v_p + v_s)$ and $V = v_p + v_s$, where v_p is the volume of the dry particle and v_s is that of the solvent included in it. Through simple algebra, this reduces to $I = AN[(\rho_p - \rho_s)v_p]^2$. Hence only the parameters v_p and ρ_p of the dry particle can be measured.

This formalism also applies to the contrast variation method, where the scattering density of the particle is matched by that of the solvent; the matching point will always be obtained for $\rho_s = \rho_p$. Hence, for micelles, it is the scattering density ρ_p of the dry micelle that is measured; solvent molecules in the micelle are not seen by this method.

We know only two ways of measuring solvent penetration in micelles through neutron scattering: one is to go to large scattering vectors ($0.6\ \text{Å}^{-1}$), where the structure of the micelle can be resolved[4]; the other is to use concentrated solutions of strongly interacting micelles[5], for then the hydration water increases the effective volume fraction, which becomes a thermodynamic quantity measured through $I(0)$. The general conclusion is that bound water is important (eight per headgroup) but is excluded from the core.

Thus, we believe that the author's conclusion is correct for reasons other than those given in their letter; their method does not, however, prove the point. This was also overlooked by others[6], who have concluded that water is excluded from near the ionic headgroups of micelles. If this method was taken at face value for other colloidal systems it could lead to misleading results.

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CHEN AND DILL REPLY—We agree with Cabane's point regarding the contrast variation technique, mentioned in the first paragraph on page 44 of our article[1]. But we must emphasize that the original paper by Bendedouch *et al.*[2] did contain firm evidence that there is little penetration of water into the micellar core and that substantial hydration occurs at the outer layer of the micelle where the headgroups of the surfactant molecules reside.

Quoting the analysis procedure used in ref. 2, the differential scattering cross-section per unit volume, for a nearly mono-dispersed and nearly spherical system of micelles isotropically dispersed in solution, is

$$\frac{d\Sigma}{d\Omega}(q) = n_p P(q) S(q\sigma) \qquad (1)$$

where n_p is the number of micelles per unit volume calculable from the surfactant concentration and the aggregation number, $P(q)$ the particle structure factor and $S(q\sigma)$ the interparticle structure factor. The information on micellar structure, aggregation number and hydration comes from both factors $P(q)$ and $S(q\sigma)$. $(d\Sigma/d\Omega)(q)$ is the differential cross-section per unit volume.

For experiments that measure the cross-section at 'zero' q and, for small q (such that $q \times \text{size} < 1$), one can write

$$P(q) = P(0) \exp(-q^2 R_g^2/3) \qquad (2)$$

$$P(0) = \int_V d^3 r(\rho(r) - \rho_s) \qquad (3)$$

and

$$R_g^2 = (P(0))^{-1} \int_V d^3 r\, r^2 (\rho(r) - \rho_s) \qquad (4)$$

Using standard notation.

The contrast variation technique which is based on measurements of the zero angle intensity, $P(0)$, indeed contains no information on the solvent (water) penetration and the hydration, because in equation (3) the integration over the volume of the micelle (V) involves the difference of scattering length densities of the micelle and the solvent. Analysis of our 'internal contrast variation' data, more accurate than the 'external contrast variation' data, gives an aggregation number $\bar{n} = 78$ and a dry volume per monomer $V_m = 402\ \text{Å}^3$ (refs 2, 3).

The analysis of the finite q data gives, from equation (2), the radius of gyration, R_g, which, by definition in equation (4), is related to the actual volume V of the micelle (as opposed to the dry volume) and hence would give information on the solvent penetration and hydration. Guinier plots of small q data[2] give the same value of $R_g = 15.4$ Å, independently of the degree of deuteration of the tail groups, which means that the scattering of neutrons is dominated by the hydrophobic tail part of LDS (lithium dodecyl sulphate) monomers forming the core of the micelle. If one assumes that the tails form a close-packed ellipsoidal core with