Discovery of the platonic micelles that have a discreet aggregation number chosen from 4, 6, 8, 12, and 20

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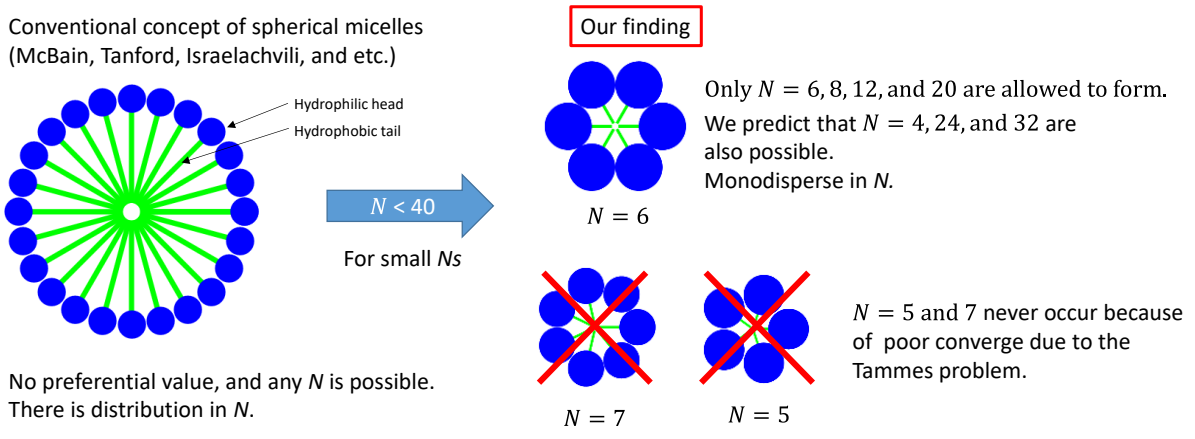
The concept of micelles was first proposed in 1913 by McBain and has rationalized numerous experimental results of the self-aggregation of surfactants. It is generally agreed that the aggregation number (N_{agg}) for spherical micelles has no exact value and a certain distribution. However, our studies of calix[4]arene surfactants showed that they were monodisperse with a defined N_{agg} whose values are chosen from 4, 6, 8, 12, 20, and 32. Synchrotron small-angle X-ray scattering patterns exhibited a sharp intensity dump, indicating high symmetry and shape monodispersity. The size monodispersity of the micelles was confirmed with analytical ultracentrifugation. Interestingly, some of the observed N_{agg} coincide with the face numbers of Platonic solids, thus we named them "platonic micelles". The preferred N_{agg} values were explained in relation to the mathematical Tammes problem: how to obtain the best coverage of a sphere surface with multiple identical circles. The coverage ratio $D(N)$ can be calculated and produces maxima at $N = 6, 12, 20, \text{and } 32$, coinciding with the observed N_{agg} values. We presume that this "platonic nature" may hold for any spherical micelles when N_{agg} is sufficiently small. Now, we are in the middle of applying this new micellar nature to construct a new drug delivery system.



References

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