Changes in Membrane Phospholipid Composition in Mammalian Tissues with Body Mass and a Potential Secret of Cardiolipin.

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The 'Membrane Pacemaker Theory of Metabolism' proposes that by influencing membrane energy consuming processes, membrane lipid composition is a determinant of metabolic rate. In mammals, as body size decreases, metabolic rates increase and tissue membrane lipid composition (except brain) becomes increasingly unsaturated (more -C=C-) as monounsaturated fatty acids are replaced by polyunsaturated fatty acids. This requires changes in the molecular composition of membrane phospholipids. Phospholipid molecular species were examined in kidney and brain, of mouse, sheep and cow, using mass spectrometry. Results confirmed changes in unsaturation in kidney, but not in brain (as expected) with increases in polyunsaturated and decreases in monounsaturated fats with decreased body mass. Importantly, changes in phospholipid molecular composition was not restricted to any specific phospholipid molecule or to any specific phospholipid class, but was spread across the phospholipid classes. In the three mammals examined, phosphatidylcholine and phosphatidylethanolamine combined constituted ~91% and ~88% of all phospholipids in kidney and brain. In a different study, investigation of cardiolipin (~20% of mitochondrial phospholipid) found ~20x greater levels of peroxidation than for other phospholipids with the same peroxidation potential. Based on the experimental set-up we propose that cardiolipin may undergo peroxidation at much low oxygen levels than other phospholipids.