# Saturated fatty acid levels increase when making memories

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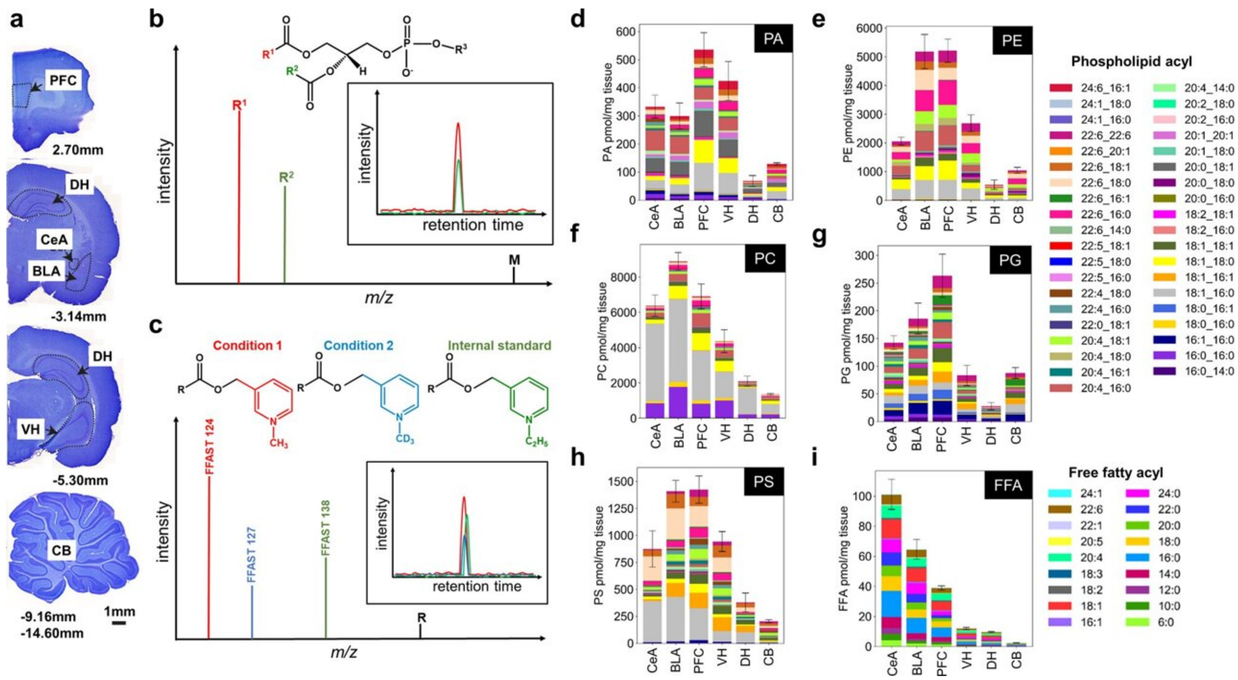


Fig. 1: Distribution of free fatty acid (FFA) and phospholipid in the rat brain. a For each of the 32 animals used in this study, tissue was dissected from the basolateral amygdala (BLA), central amygdala (CeA), the prefrontal cortex of the forebrain (PFC), ventral hippocampus (VH), dorsal hippocampus (DH) and cerebellum (CB), as indicated by dotted lines on Cresyl violet-stained brain sections with corresponding Bregma co-ordinates. Scale bar = 1 mm. b Identification and quantification of phospholipids using diagnostic ion fragmentation in liquid chromatography mass spectrometry (LCMS). Shown is a hypothetical phospholipid negative mode fragmentation mass spectrum. The parent (M), sn-1 (R1) and sn-2 (R2) fragment ion masses are unique to each species, and are used for multiple reaction monitoring (MRM, inset) LCMS to

quantify abundance. c Schematic representation of FFA analysis using Free Fatty Acid Stable isotope Tagging (FFAST). For a given brain region the FFAs extracted from animals from different experimental conditions (saline paired, saline unpaired, CPP paired, CPP unpaired, see Fig. 2) were individually labelled at the carboxy-terminus using FFAST-124 or FFAST-127. Samples were combined, spiked with FFAST-138-labelled internal standards, and analyzed by LCMS. The 3 labelled variants of each FFA species display similar chromatographic elution times, and the ratio of each FFAST fragment relative to the internal standard fragment allows quantification of the abundance of the FFA in the condition. This workflow was repeated 8 times, to establish FFA abundance in each of the 8 animals used in each experimental condition. d–i Profile measurements of FFAs and 5 classes of phospholipids (PA—phosphatidic acid, PC—phosphatidylcholine, PE—phosphatidylethanolamine, PG—phosphatidylglycerol, PS—phosphatidylserine) across the brains of the control (saline unpaired) rats from auditory fear conditioning experiments, with analytes shown by acyl chain composition. Bars represent the total analyte measurement, with coloured sub-bars corresponding to the mean individual analyte concentrations (pmol/mg tissue) observed across 8 animals. Error bars represent the cumulative standard error of the mean (SEM) for all analytes. Source data are provided as a Source Data file. From: Saturated free fatty acids and association with memory formation

Saturated fatty acid levels unexpectedly rise in the brain during memory formation, according to University of Queensland research, opening a new avenue of investigation into how memories are made.

Dr. Tristan Wallis, from Professor Frederic Meunier's laboratory at UQ's Queensland Brain Institute (QBI), said traditionally, polyunsaturated fatty acids were considered important to health and memory, but this study highlighted the unexpected role of saturated fatty acids.

"We tested the most common fatty acids to see how their levels changed as new memories were formed in the brain," Dr. Wallis said.

"Unexpectedly, the changes of saturated fat levels in the brain cells were the most marked, especially that of myristic acid, which is found in coconut oil and butter.

"In the kitchen, saturated fats are those which are solid at room temperature while unsaturated fats are normally liquid.

"The brain is the fattiest organ in the body, being 60 percent fat, which provides energy, structure and assists in passing messages between brain cells.

"Fatty acids are the building blocks of lipids or fats and are vital for communication between nerve cells, because they help synaptic vesicles —microscopic sacs containing neurotransmitters—to fuse with the cell membrane and pass messages between the cells.

"We have previously shown that when brain cells communicate with each other in a dish, the levels of saturated fatty acids increase."

Researchers have found that fatty acid levels in the rat brain, particularly saturated fatty acids, increase as memories are formed, but when they used a drug to block learning and memory formation in rats, the fatty acid levels did not change.

The highest concentration of saturated fatty acids was found in the amygdala—the part of the brain involved in forming new memories specifically related to fear and strong emotions.

Study contributor and QBI Director Professor Pankaj Sah said the work opened a new avenue on how memory was formed.

"This research has huge implications on our understanding of synaptic plasticity—the change that occurs at the junctions between neurons that allow them to communicate, learn and build memories," Professor Sah said.

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