Increased Fluidity in Adipose Membranes from Genetically Obese Pigs is Independent of Carbon Chain Length and Unsaturation Degree of Fatty Acids

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Obesity epidemic continues to rise despite increased public awareness to control body weight. Considerable uncertainty on the dietary causes of obesity still remains. In this study, 24 male pigs from distinct genetic breeds, lean and obese, were fed on normal (18%) and reduced (14%) protein diets within a 2 × 2 factorial arrangement. We aimed to assess the effect of genetic background and restriction of dietary protein on the lipid composition, including cholesterol, fluidity and permeability of adipose membranes in the pig, as experimental model. Fat thickness was twofold higher in obese than in lean pigs but unrelated to dietary protein level. In contrast, total fatty acids in the subcutaneous adipose tissue were dependent on both breed and diet, with increased lipid content promoted by the obese genotype and by the restriction of dietary protein. We next isolated adipose membrane vesicles from subcutaneous fat tissue which were osmotically responsive for transport experiments. Adipose membrane vesicles from obese pigs were more fluid than from lean pigs, as determined by DPH probe. This is in line with increased water permeability in obese pigs. This permeation occurs through the lipid bilayer without contribution of specific protein channels for transport. Moreover, the reduced level of dietary protein impacted positively on the fluidity of adipose membranes. Neither breed nor diet affected the cholesterol content in the adipose membranes. While membrane-SFA was influenced by breed, membrane-PUFA, particularly the *n*-6 family, was influenced by diet. In fact, SFA content was higher in obese pigs whereas PUFA was lower in diets restricted on protein. Apart from the positive correlation between PUFA/SFA index and DPH, this probe was inversely correlated with 18:1*c*9/18:2*n*-6 ratio. In summary, this study introduces dietary protein restriction as a determinant player on adipocytes membrane fluidity. In addition, it reinforces the genetic background importance on membrane rigidification of fat cells and subsequent water fluxes in the pig model. Both factors combined or individually may, through an unknown extent, impact on human obesity onset and metabolic consequences.