Detection of Sialic Acids in Adipose Tissue of Adventist Health Study-2 Participants with Different Dietary Patterns

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Abstract

Sialic acids (Sias) are a class of sugar molecules with a parent nine-carbon neuraminic acid, generally present at the ends of carbohydrate chains, either attached to cellular surfaces or as secreted glycoconjugates. Given their position and structural diversity, Sias modulate a wide variety of biological processes. However, limited information is available about the role of Sias in human adipose tissue, particularly in the context of dietary patterns, and the implications for health and disease. It is known that excessive adipose accumulation, which is usually associated with unhealthy dietary habits, may lead to abnormal secretion of adipocytokines, which may promote inflammation and trigger processes associated with diabetes, cancer, and cardiovascular disease. Sias, which have shown associations with inflammation, might regulate these disease processes.

The objectives of this study were to 1) develop a method to extract, detect, and quantify KDN, Neu5Gc, and Neu5Ac from adipose tissue using Liquid Chromatography Mass Spectrometry (LC-MS/MS), given its sensitivity and specificity, and 2) compare the abundance of these Sias in 161 Adventist Health Study-2 (AHS-2) participants following habitual, long-term vegetarian (vegan, n=52; Lacto-ovo, n=59) and non-vegetarian (n=50) dietary patterns. Furthermore, the content of Sias from adipose tissue in animals was assessed to verify the ability of the developed method to detect Sias in other biological sources.

A method was successfully developed for the extraction and detection of Sias in adipose tissue, and samples were analyzed through LC-MS/MS. Neu5Ac and KDN were extracted, detected, and quantified in human adipose from vegetarians and non-vegetarians. Vegans showed statistically higher concentrations of Neu5Ac relative to non-vegetarians. This association was somewhat attenuated after adjustment for BMI, which was also found to be inversely associated with Sias. Hence, it is probable that BMI mediates the effect of diet. The non-human, red-meat derived Neu5Gc was not detected in human adipose tissue, and is either not present in human adipose tissue, or undetectable with our method and the LC-MS/MS equipment used in this study. The developed method allowed for the detection of Neu5Ac, KDN, and Neu5Gc in adipose tissue of animals expected to have these Sias.

The lower concentration of Sias in adipose tissue of non-vegetarians or those with higher BMI might help explain the increased risk of cardiovascular diseases for these individuals. Our method for detection of Sias may be used in future studies with human samples to understand the role of Sias in the development and progression of chronic diseases.

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