Promiscuities in Sialic Acid Biosynthesis in Vertebrates and Invertebrates

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N-acetylneuraminic acid (Neu5Ac) is synthesized in nature by a class of enzymes called Neu5Ac aldolases (NPLs), which catalyze the aldol addition of ManNAc and pyruvate. Given the close homology between Neu5Ac aldolases in bacteria and animals, we examined if recombinant NPLs from mammalian origin (i.e. from human, hNPL), avian origin (i.e. from chicken, chNPL), and from lower animals (i.e. from snail or oyster, respectively, sNPL and oNPL) showed similar substrate promiscuities. The results and implications of these findings will be presented.

In contrast to the mammalian and avian NPLs, which can synthesize and degrade Neu5Ac, sNPL and oNPL were not able to catalyze the cleavage of N-acetylneuraminic acid into N-acetylmannosamine and pyruvate. Interestingly, the NPLs from higher animals showed contrasting C4(*R*)/(*S*) diastereoselectivity towards the substrates D-mannose and D-galactose in the presence of pyruvate compared to the NPLs from lower animals. In addition, sNPL was able to synthesize a series of 4-hydroxy-2-oxoates using the corresponding aliphatic aldehyde substrates in the presence of pyruvate, which could not be achieved by the mammalian or avian NPLs.

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