

# Improve BBB penetration via Glycosylation

## Introduction

Whereas hydroxylation, methylation, fluorination etc. are in the mainstream of medicinal chemistry and ADMET thinking, attaching carbohydrates to improve molecules is considered rather more exotic or not at all (despite an abundance of examples of natural molecules that gain, alter or lose activity by glycosylation or de-glycosylation).

Even if this is considered, glycoside chemistry is difficult. Chemical glycosylation is not in itself straightforward, and since many interesting molecules have more than one or even many "glycosylatable" side groups (-OH, -COOH, -NH, -SH), all the other groups but the one in question need to be chemically blocked, a very tedious process.

Using small molecule glycosyl-transferase enzymes almost any given molecule (with appropriate side groups) can be glycosylated, most often regio-specifically (thus abolishing the need for side group blocking), in many cases even stereo-specifically and, if needed, with a number of different sugars (glucose, galactose, xylose, glucuronic acid, rhamnose etc.).

## Dopamine

Bonina et al. demonstrated activity of Dopamine in Parkinson's models by linking glucose (GLU) to Dopamine (DOM) to form a DOM-GLU prodrug and also by linking galactose (GAL) to form a DOM-GAL prodrug. Normally Parkinson's patients receive L-DOPA which can pass the blood-brain barrier (BBB) and then be converted into Dopamine once inside the brain. There are, however, issues with long term L-DOPA treatment, e.g., extensive metabolism and plasma level fluctuations, and therefore, direct uptake of DOM could be attractive. In this study it was shown that DOM-GAL (and possibly also DOM-GLU) were transported across the BBB (likely through the so-called GLUT transporters) and worked better than L-DOPA to reverse symptoms in both of two classical Parkinson's animal models; reserpine-induced hypo-locomotion (in rats) and morphine-induced locomotion (in mice).

<https://www.ncbi.nlm.nih.gov/pubmed/12852438>

## Glycosylated endorphins

Egleton et al. demonstrated that O-linked glycosylation on Ser6 of a linear opioid peptide amide Tyr-d-Thr-Gly-Phe-Leu-Ser-NH<sub>2</sub> led to a significant increase in enzymatic stability in both serum and brain. The study data indicated that glycosylation significantly increased the BBB permeability (2X) and significantly improved analgesia after i.v. administration compared with non-glycosylated peptide.

[https://scholar.google.ch/scholar?q=Egleton+et+al.+\(2001\),+J+Pharm+Exp+Ther+299:+967&hl=de&as\\_sdt=0&as\\_vis=1&oi=scholar](https://scholar.google.ch/scholar?q=Egleton+et+al.+(2001),+J+Pharm+Exp+Ther+299:+967&hl=de&as_sdt=0&as_vis=1&oi=scholar)

Glycosylation provides remarkable opportunities for improving characteristics, use and production of small molecules that are not currently being taken advantage of. River Stone has significant proprietary knowledge as well as a collection of diverse enzymes that have the potential to help our customers doing just that.



### What is the Gly-it platform?

The Gly-it platform is a library of 380 diverse “Family 1” UDP-glucose dependent glycosyltransferase enzymes (UGTs) plus associated screening, analytical and lab scale production protocols (“Family 1” denotes glycosyltransferases that will glycosylate small molecules).

All the enzymes in Gly-it are found in plants (which have diverse UGTs to work with the diverse range of small molecules that occur in plants or their environment). The kit contains enzymes from all known Family 1 UGT sub-families and sub-sub-families and from a wide set of evolutionarily diverse plants.

The majority of the enzymes will be able to add glucose to small molecule substrates with relevant functional groups. Some enzymes will work with other sugars (such as xylose, rhamnose, galactose or glucuronic acid). We can advise you on the best path for specific sugars.

**We realize that this may be your first step in determining if Gly-it technology will be able to help you in your current project. We are happy to assist you in determining if Gly-It is the right fit.**

To discuss, or for more help, just get in touch. We would like to make sure Gly-it is a proper fit for your current goals.

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