Two binding proteins of the ABC transporter that confers growth of Bifidobacterium animalis subsp. lactis ATCC27673 on β-mannan possess distinct manno-oligosaccharide-binding profiles

Human gut bifidobacteria rely on ATP-binding cassette (ABC) transporters for oligosaccharide uptake. Multiple oligosaccharide-specific solute-binding protein (SBP) genes are occasionally associated with a single ABC transporter, but the significance of this multiplicity remains unclear. Here, we characterize BlMnBP1 and BlMnBP2, the two SBPs associated to the β-manno-oligosaccharide (MnOS) ABC transporter in Bifidobacterium animalis subsp. lactis. Despite similar overall specificity and preference to mannotriose ($K_d \approx 80 \text{ nM}$), affinity of BlMnBP1 is up to 2570-fold higher for disaccharides than BlMnBP2. Structural analysis revealed a substitution of an asparagine that recognizes the mannosyl at position 2 in BlMnBP1, by a glycine in BlMnBP2, which affects substrate affinity. Both substitution types occur in bifidobacterial SBPs, but BlMnBP1-like variants prevail in human gut isolates. B. animalis subsp. lactis ATCC27673 showed growth on gluco and galactomannans and was able to outcompete a mannan-degrading Bacteroides ovatus strain in co-cultures, attesting the efficiency of this ABC uptake system. By contrast, a strain that lacks this transporter failed to grow on mannan. This study highlights SBP diversification as a possible strategy to modulate oligosaccharide uptake preferences of bifidobacterial ABC-transporters during adaptation to specific ecological niches. Efficient metabolism of galactomannan by distinct bifidobacteria, merits evaluating this plant glycan as a potential prebiotic.

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