The phosphotransferase system balances nitrogen and carbon metabolism in *Rhizobium leguminosarum*

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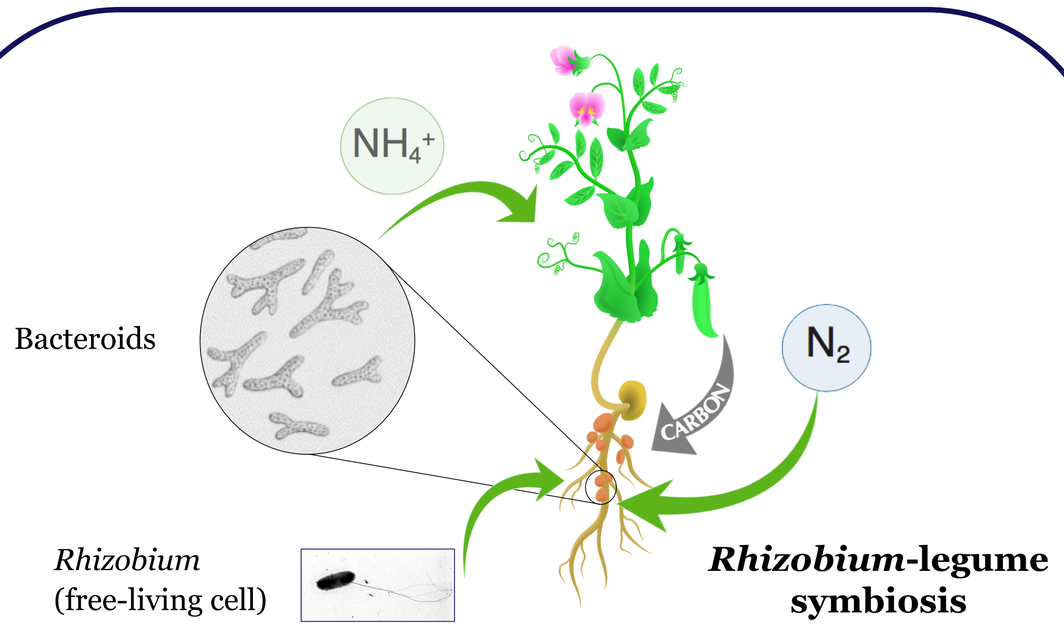
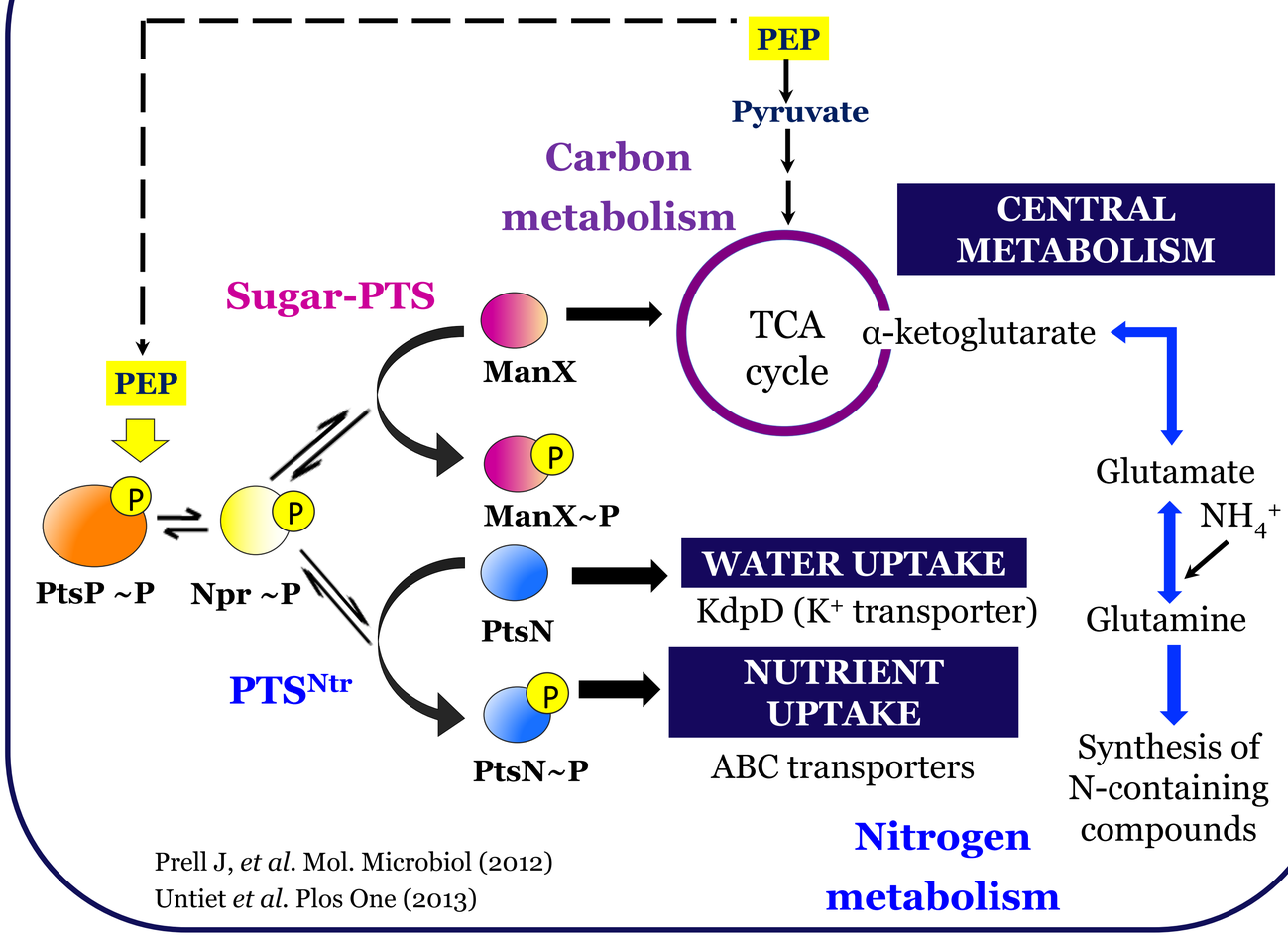


Rhizobium leguminosarum undergoes a complex and highly regulated transition from a free-living organism to a nitrogen-fixing bacteroid as it begins its relationship with its host plant. This shift requires a wide range of changes, interconnected with the nitrogen and carbohydrate metabolism.

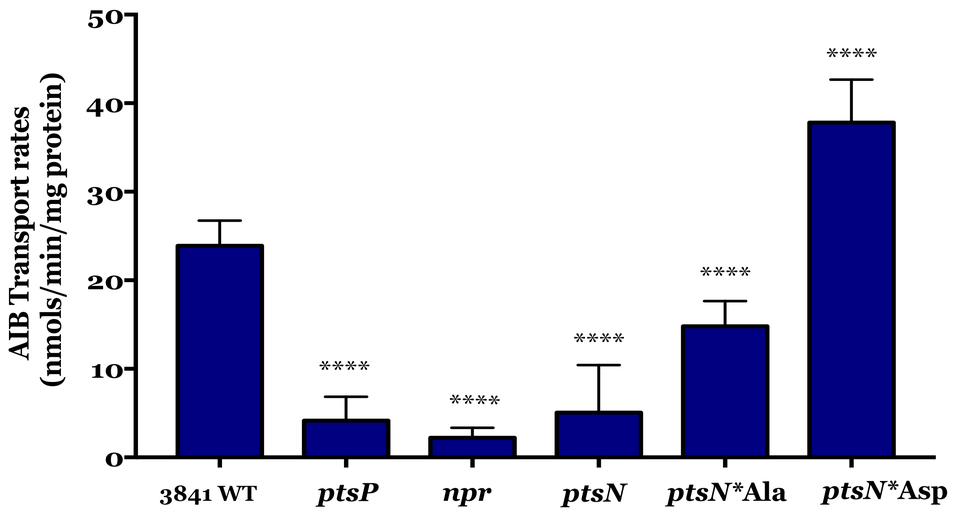
Are the PTS systems critical in enacting these changes in N-fixing bacteria?

The phosphotransferase system in *Rhizobium leguminosarum* 3841



Prell J, *et al.* Mol. Microbiol (2012)
Untiet *et al.* Plos One (2013)

NUTRIENT UPTAKE



PTS^{Ntr} mutants are defective in amino acid transport. PtsN phosphorylation is essential for ABC transport activation.

CENTRAL METABOLISM

Mean Generation Time (hours)

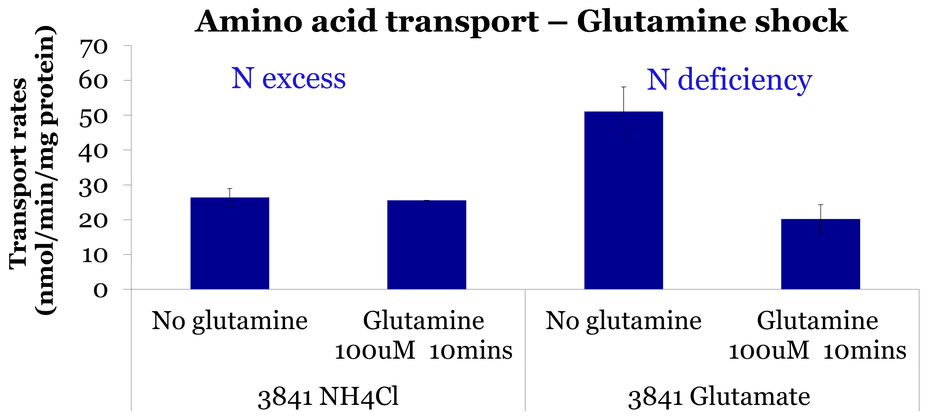
Strain	Glucose 10mM	Succinate 20mM	Glutamine 10mM	Glutamate 10mM
Wild type	**3.42 ±0.11**	**3.44 ±0.28**	**3.73 ±0.24**	**4.35 ±0.11**
manX	6.13 ±0.12	6.15 ±0.21	6.33 ±0.18	7.64 ±0.11
***manX**Ala*	3.44 ±0.17	3.42 ±0.16	3.00 ±0.43	4.71 ±0.23

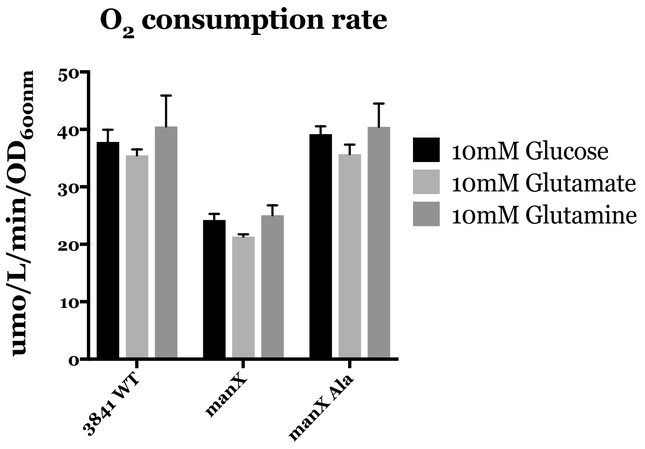
manX mutant shows a reduced growth and a compromised oxygen consumption, indicating that ManX interacts with the TCA cycle.

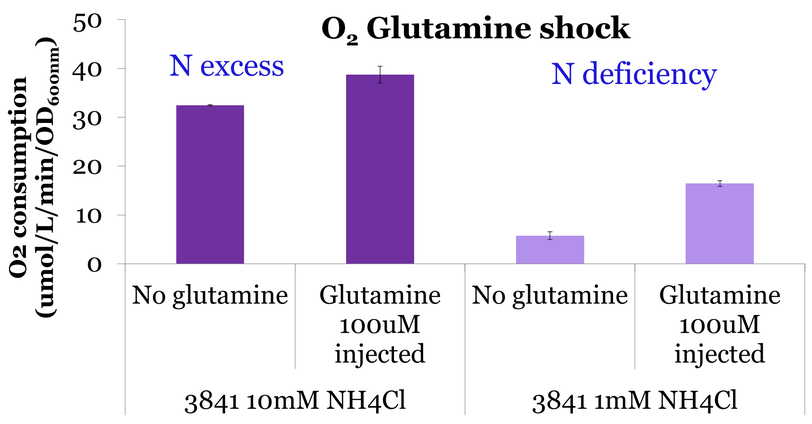
TCA enzyme	MDH activity	α-KGDH activity
Strain	(nmol/min/mg protein)	(nmol/min/mg protein)
Wild type	**949.8 ± 60.8**	**16.5 ± 1.7**
npr	910.4 ± 50.4	20.1 ± 1.0
manX	375.5 ± 30.0	4.3 ± 1.0

Accordingly, MDH and α-KGDH activities are drastically reduced in a *manX* mutant.

Glutamine is the signal coordinating the phosphorylation switch between PtsN and ManX







PTS^{Ntr}
Glutamine ⊣ GAF **PtsP** **Npr** **PtsN** → **NUTRIENT UPTAKE** (ABC transporters)

Sugar-PTS
Glutamine ⊣ GAF **PtsP** **Npr** **ManX** → **CENTRAL METABOLISM** (TCA cycle)

CONCLUSIONS

- PtsN controls K^+ homeostasis and PtsN~P ABC transporters.
- ManX controls the enzymatic activity of the TCA cycle.
- Nitrogen availability coordinates PTS systems, being glutamine the signal regulating these systems.

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CONTACT AND ACKNOWLEDEGMENTS

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