Exploring advanced approaches for enhancing the production of exopolysaccharides from acetic acid bacteria

University of Modena and Reggio Emilia
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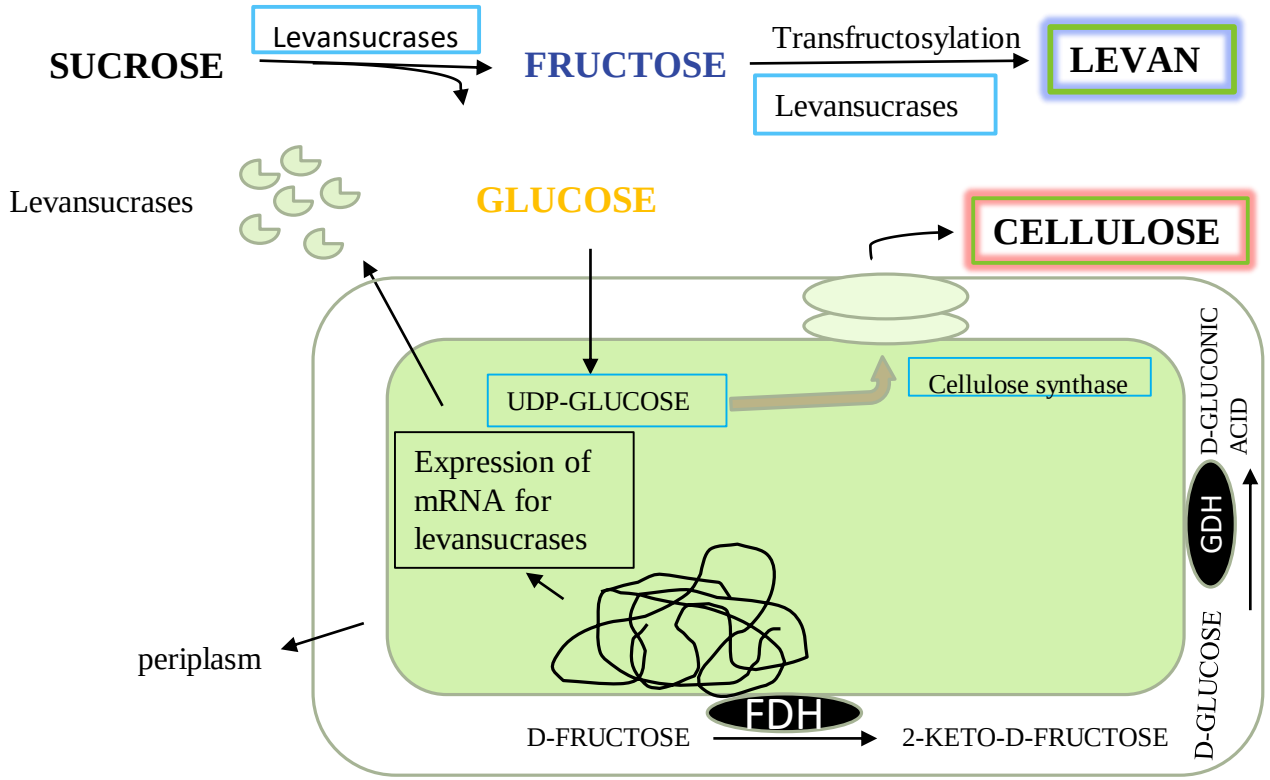
Types of exopolysaccharides and production pathway

- Acetic acid bacteria are versatile in nature
- The key compounds produced by AAB include acetic acid, bacterial cellulose, dihydroxyacetone, gluconic acid and levan
- Many studies focusing on altering culture conditions and genetically modified strains to improve yield



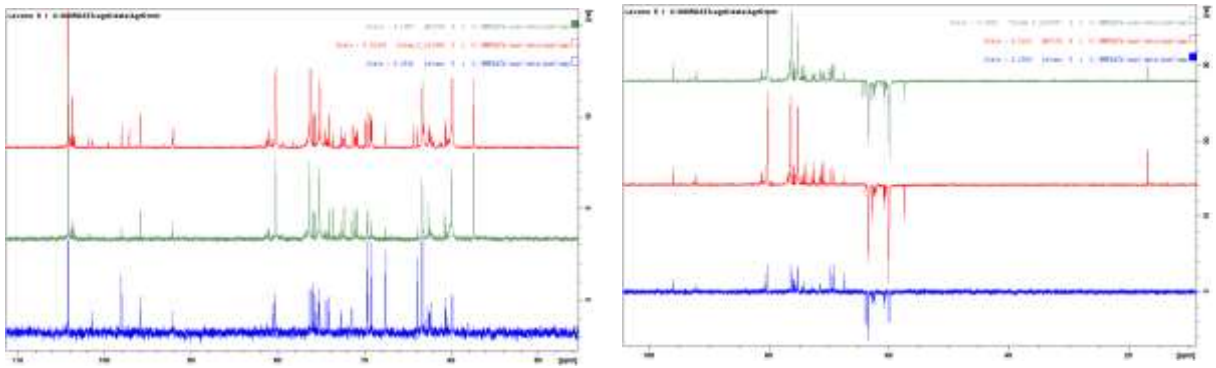
PARAMETERS

- Carbon source
- Temperature (25-35˚ C)
- pH (5.4 -6.3)
- Inoculum size
- Time of incubation

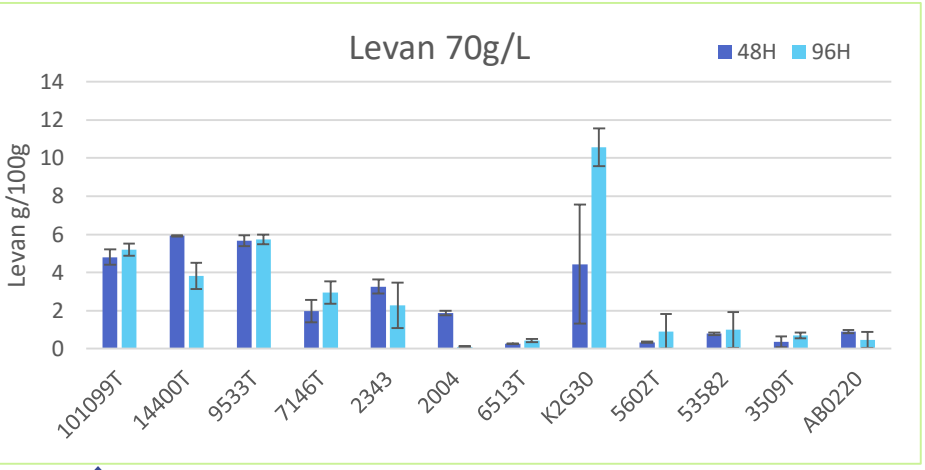
Selecting carbon source and oxygen availability for high levan yield

- Most of the AAB strains utilize sucrose as a carbon source for levan production
- 70 and 250 g/L of sucrose was used to test the levan production with 140 and 200 rpm.

EPS characterization by NMR

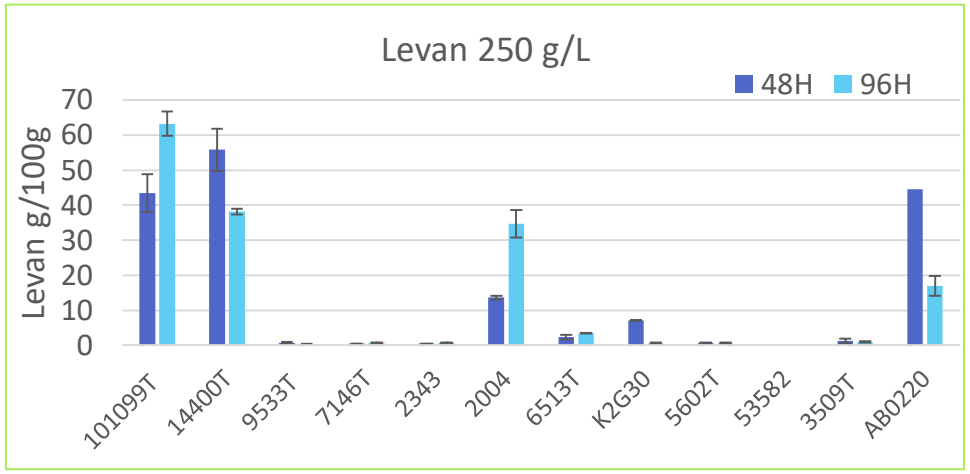


- High sucrose concentration helps in more levan formation
- High agitation speed enhance the enzyme substrate bonding



70 g/L, 140 rpm

250 g/L, 200 rpm



- Variability in phenotypic behavior was observed for utilizing carbon source and related levan yield
- Carbon source accumulation and pH is showing impact on levan yield

Evolutionary laboratory adaptation approach for BC production

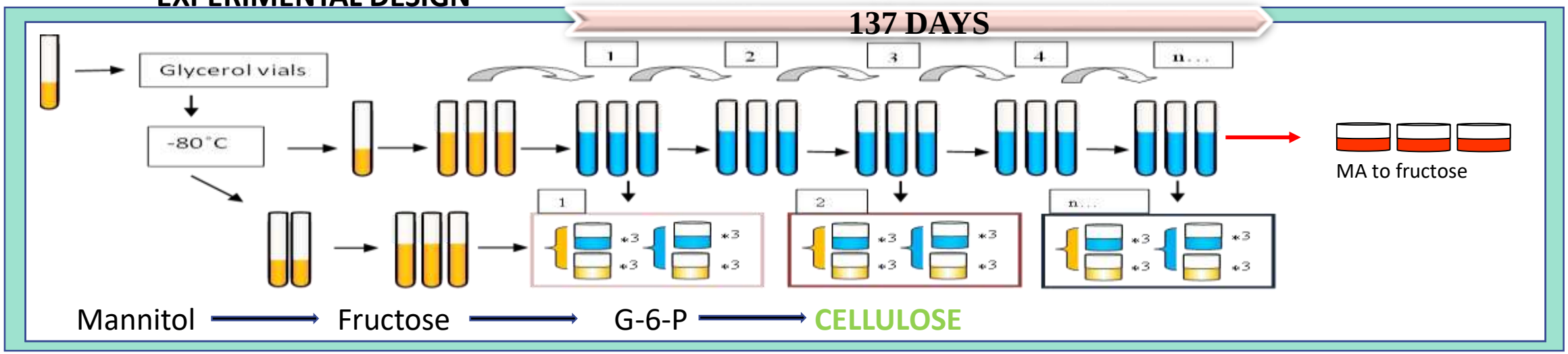
Komagataeibacter xylinus -K2G30 (UMCC 2756)

- **Adaptation ability of strain?**
- **Optimum conditions for suitable adaptation**

- Time for new adaptation and impacting factors?

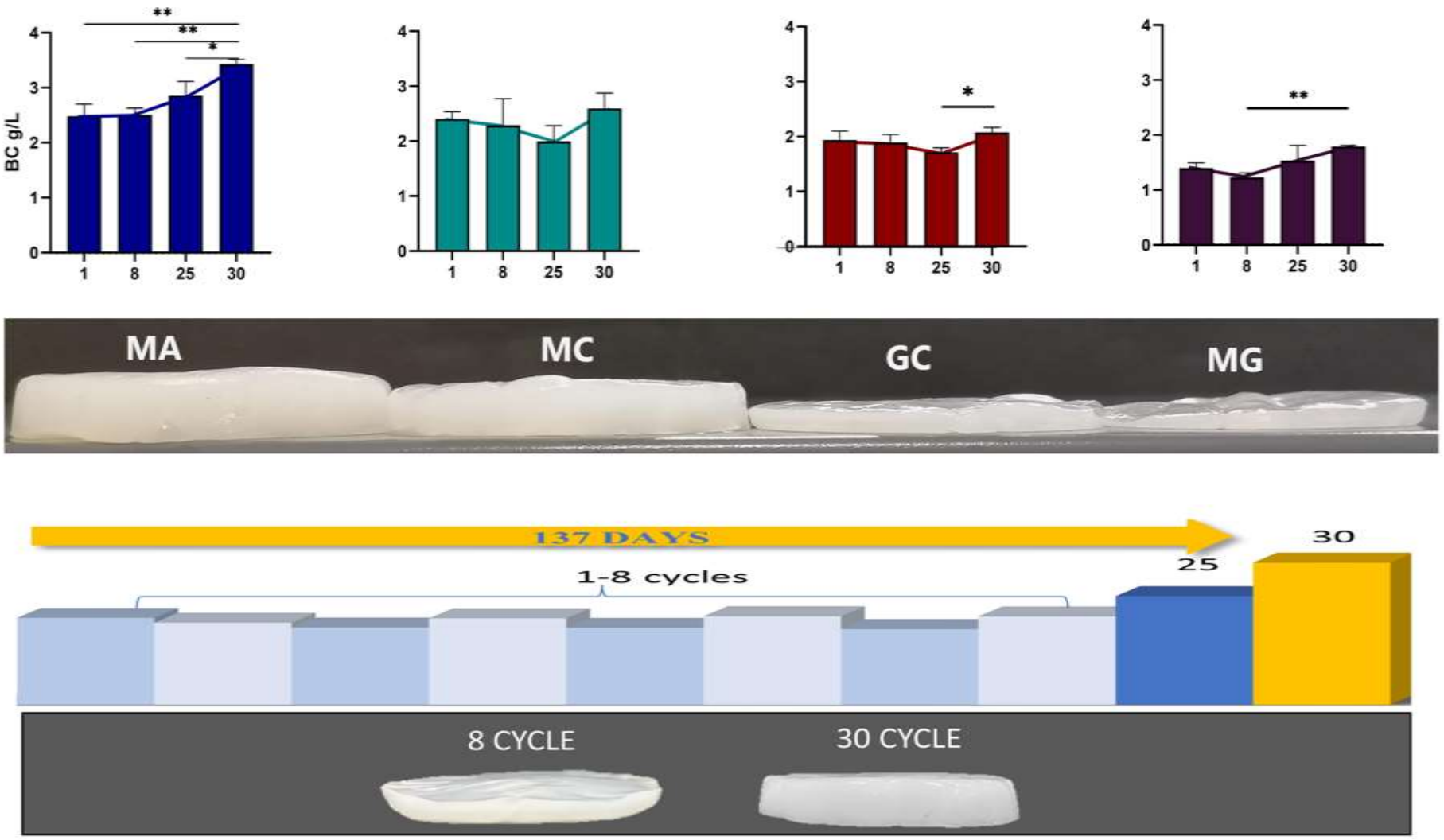
- Short-term and long-term adaptation

EXPERIMENTAL DESIGN

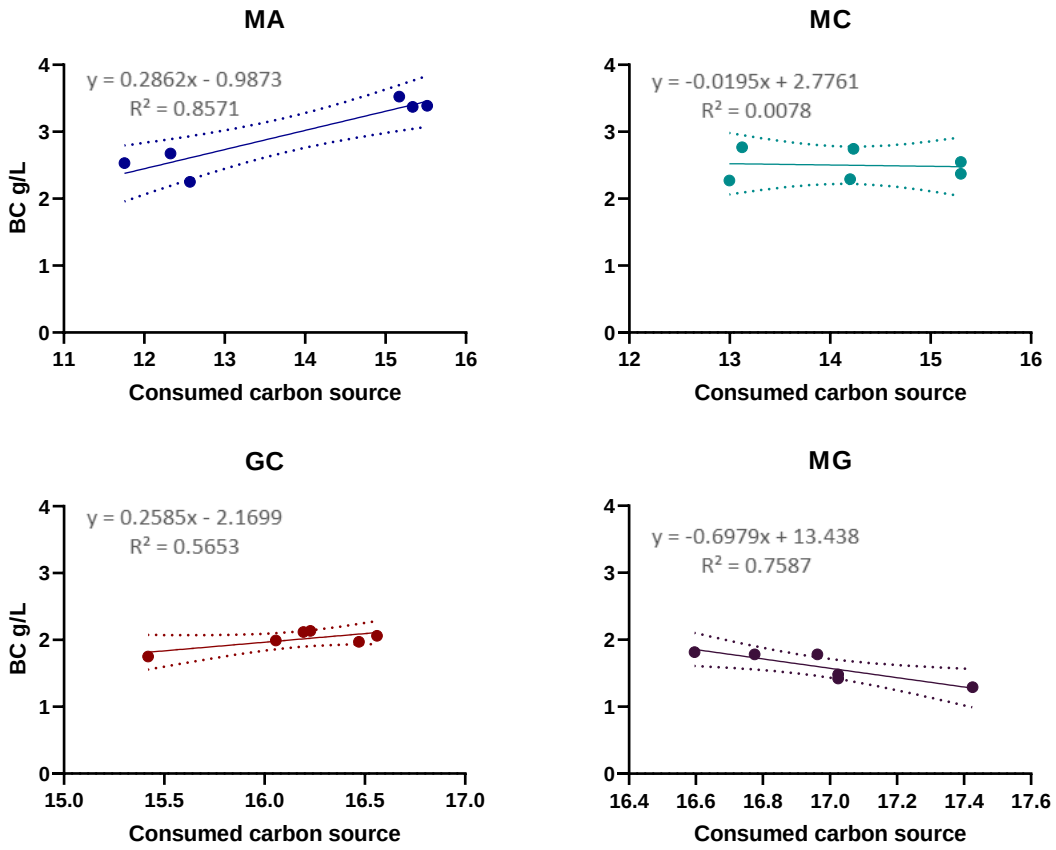


BC yield over period

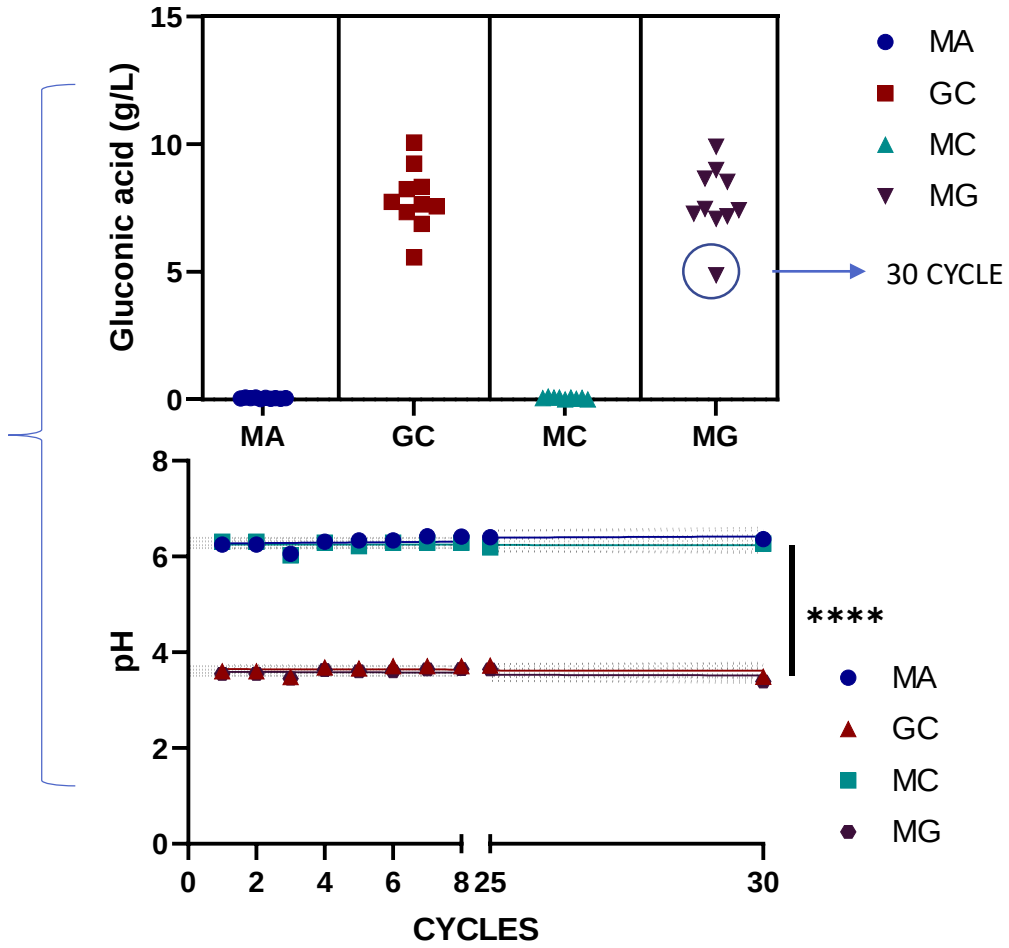
- BC yield was stable until 8 cycles which further shows 20% increase after 25 cycle of adaptation
- **At the end of 30th cycle, more than 40% increase in yield** was observed which is the highest among all conditions.
- Strain adapted in mannitol for 30 cycles also showed increase in yield in glucose medium when cultured back



Carbon source consumption vs BC



Gluconic acid and pH



- Significant differences were observed in adapted strain among carbon consumption and BC production.
- Gluconic acid production was seen only in glucose-based media which resulted in reduction of pH.
- Strain adapted in mannitol for 30 cycles showed less production of gluconic acid with increase in BC yield.

CONCLUSIONS:

- This study is helpful to understand the complex interactions between short term and long-term adaptation of strains to environmental conditions.

- Continuous adaptation of strain to the new environment resulted in great yield without any application of genetic engineering.

- Although glucose is a preferred carbon source, production of gluconic acid and low pH effecting the BC production

- Mannitol can be alternative carbon source because of its : High yield
  Stable pH

THANK YOU

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