Application of batch oscillatory baffled bioreactor to produce biobutanol using *Clostridium* GBL 1082

Nasratun Masngut
Adam P Harvey

Newcastle University

ABE fermentation

Industrial exploitation started: 1916

Acetone-butanol-ethanol fermentation

•Demand for acetone during World War
•Demand for butanol from automobile industry

Glorious term until: 1950s

Demised in late 1950s

So, why we're looking at it again?
•Interest in renewable energy

Our objectives are:

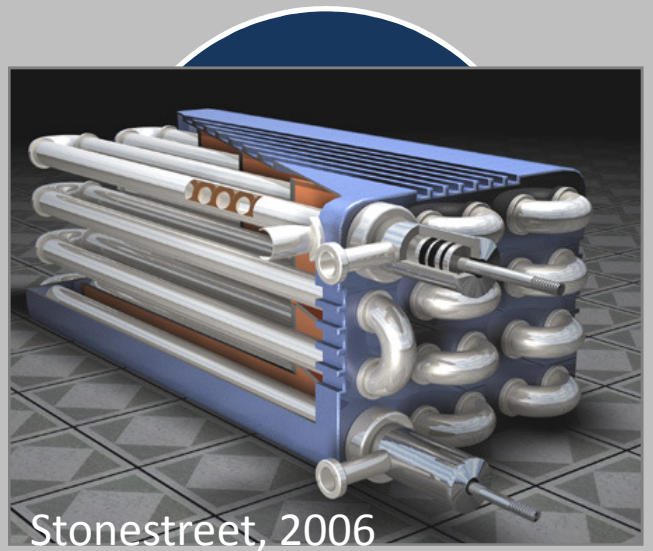
- to develop autoclaveable laboratory-scale OBBs for biobutanol production
- to produce biobutanol in OBBs at a yield of 0.30
- compare the yields and productivity with other conventional bioreactor (stirred tank and agitated Schott bottle)

Advantages of using OBB

Straightforward scale-up

Reproducible yields and productivity

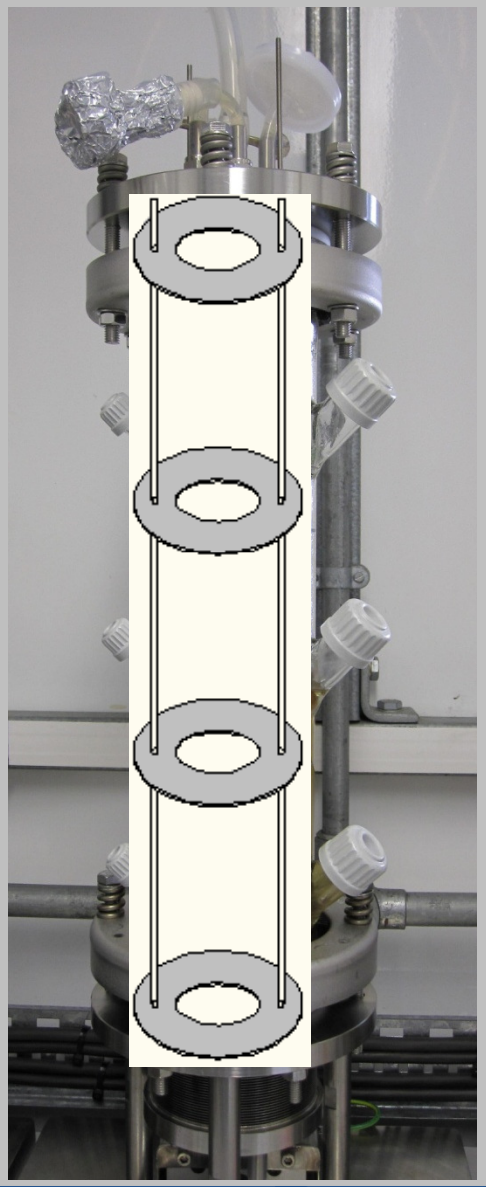
Compact design



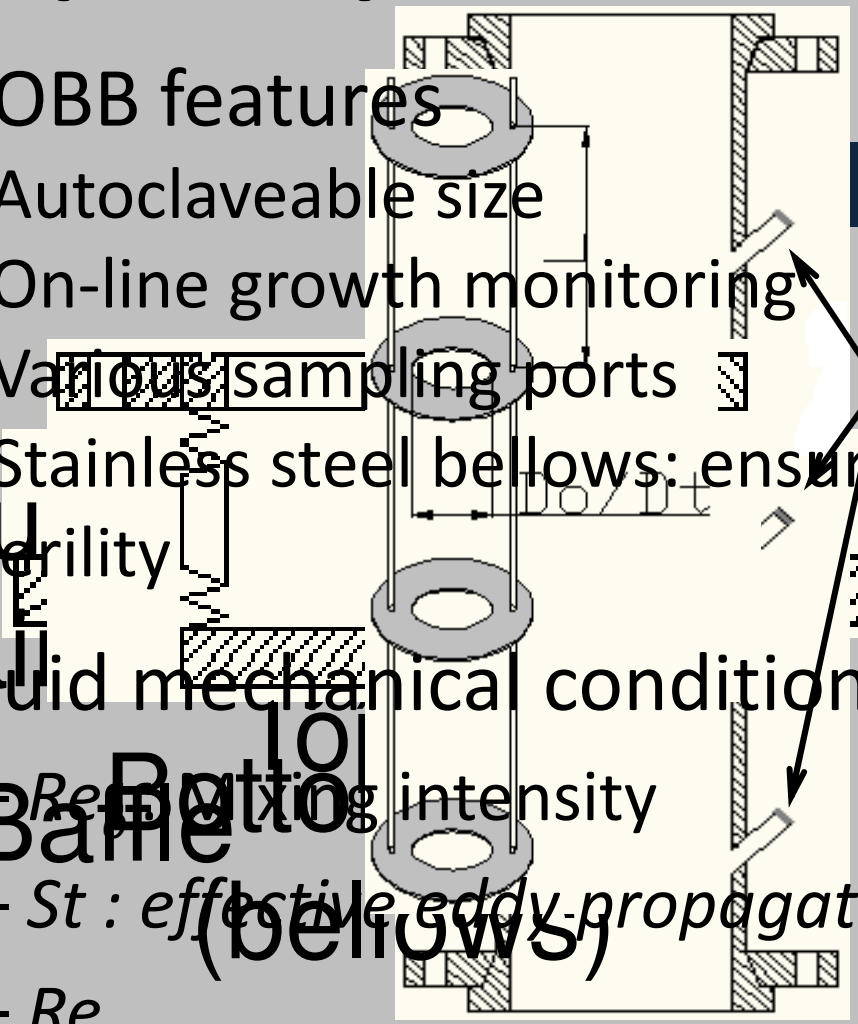
Stonestreet, 2006

Reductions in residence time

Batch oscillatory baffled bioreactor (BOBB)

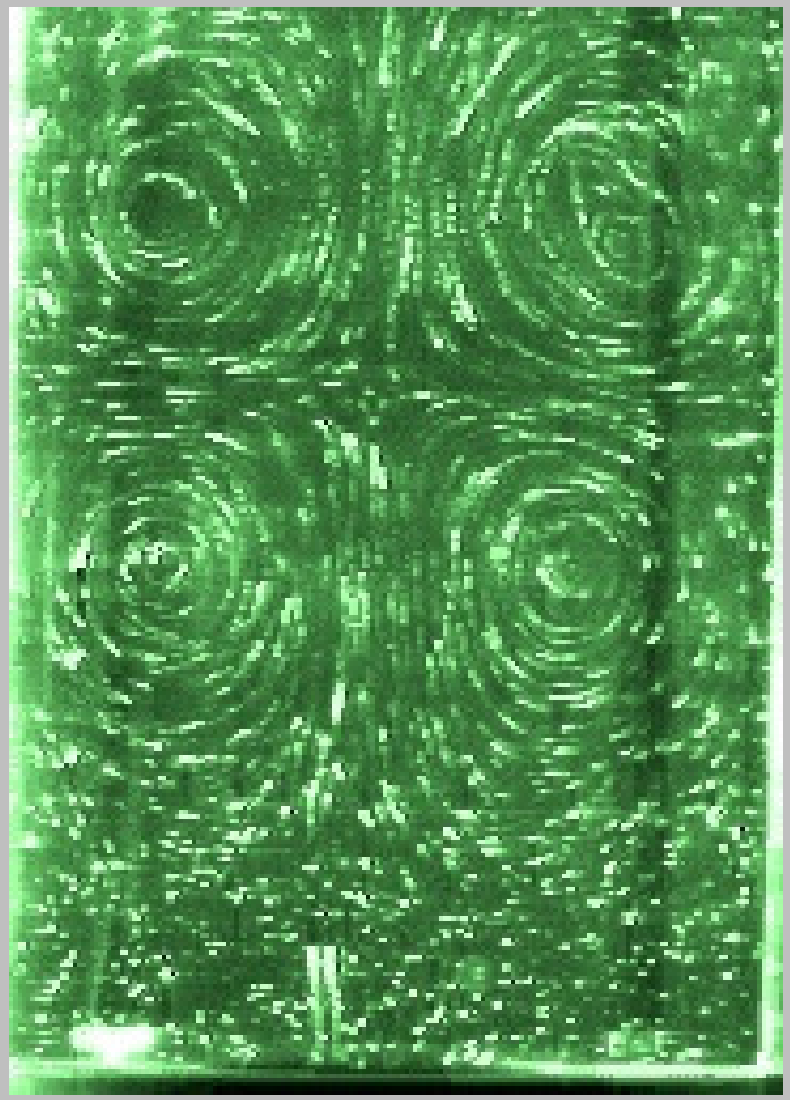


- OBB features
  - Autoclaveable size
  - On-line growth monitoring
  - Various sampling ports
  - Stainless steel bellows: ensure sterility



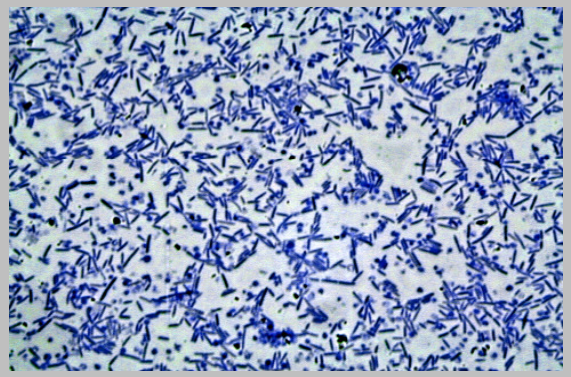
- Fluid mechanical condition:
  - *Re* : mixing intensity
  - *St : effective eddy propagation*
  - Re_n

OBB flow pattern



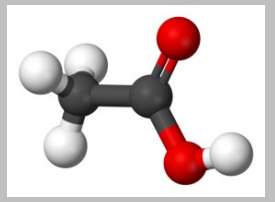
Fermentation method

Bacteria
(Clostridium GBL1082)

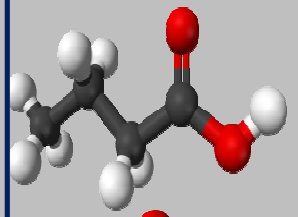


Synthetic
Molases

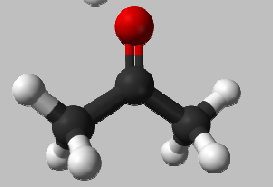
Products



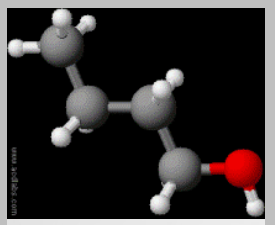
Acetate



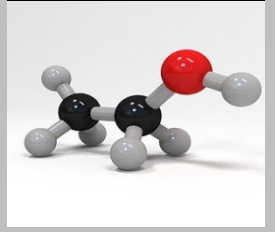
Butyrate



Acetone



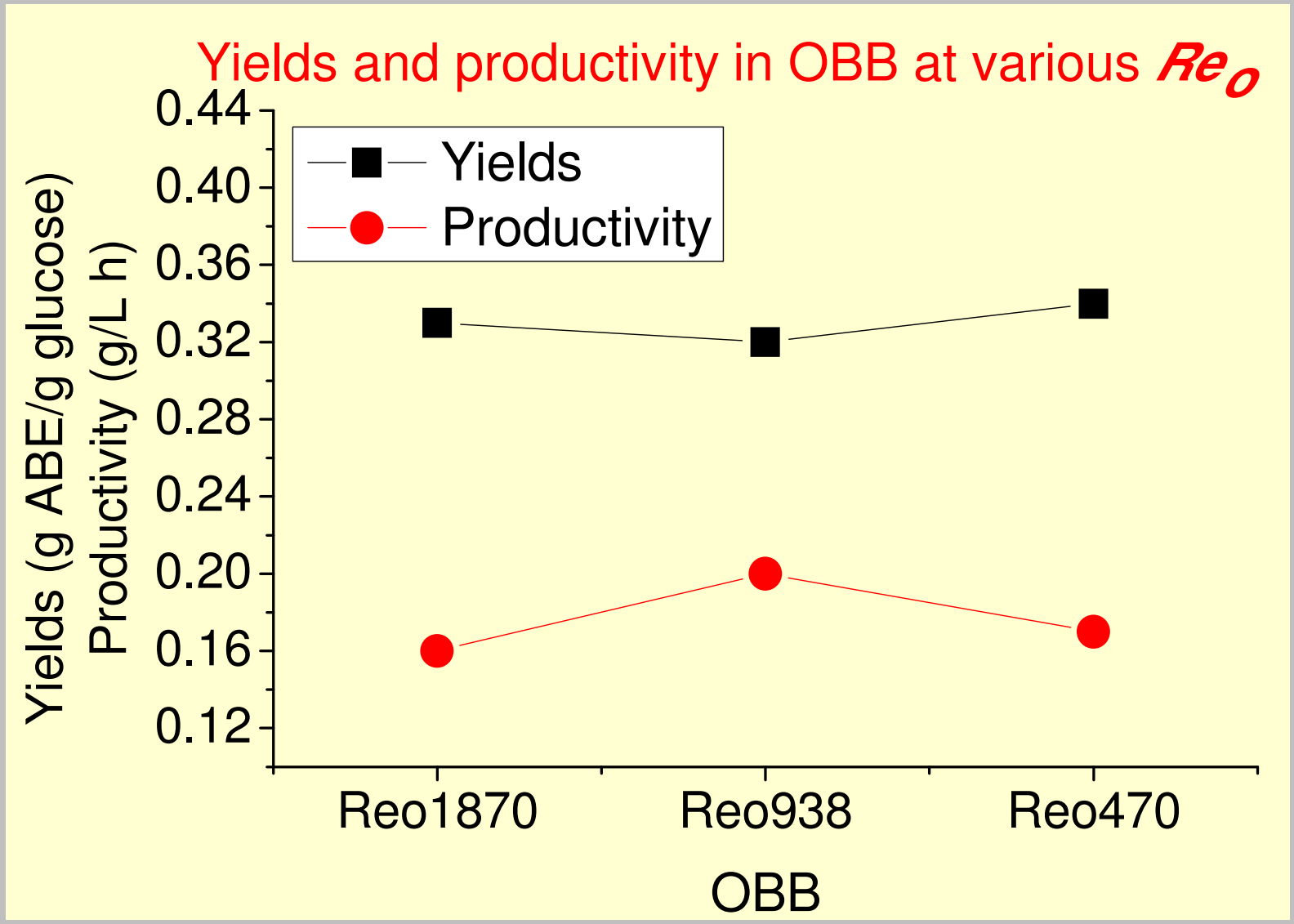
Butanol



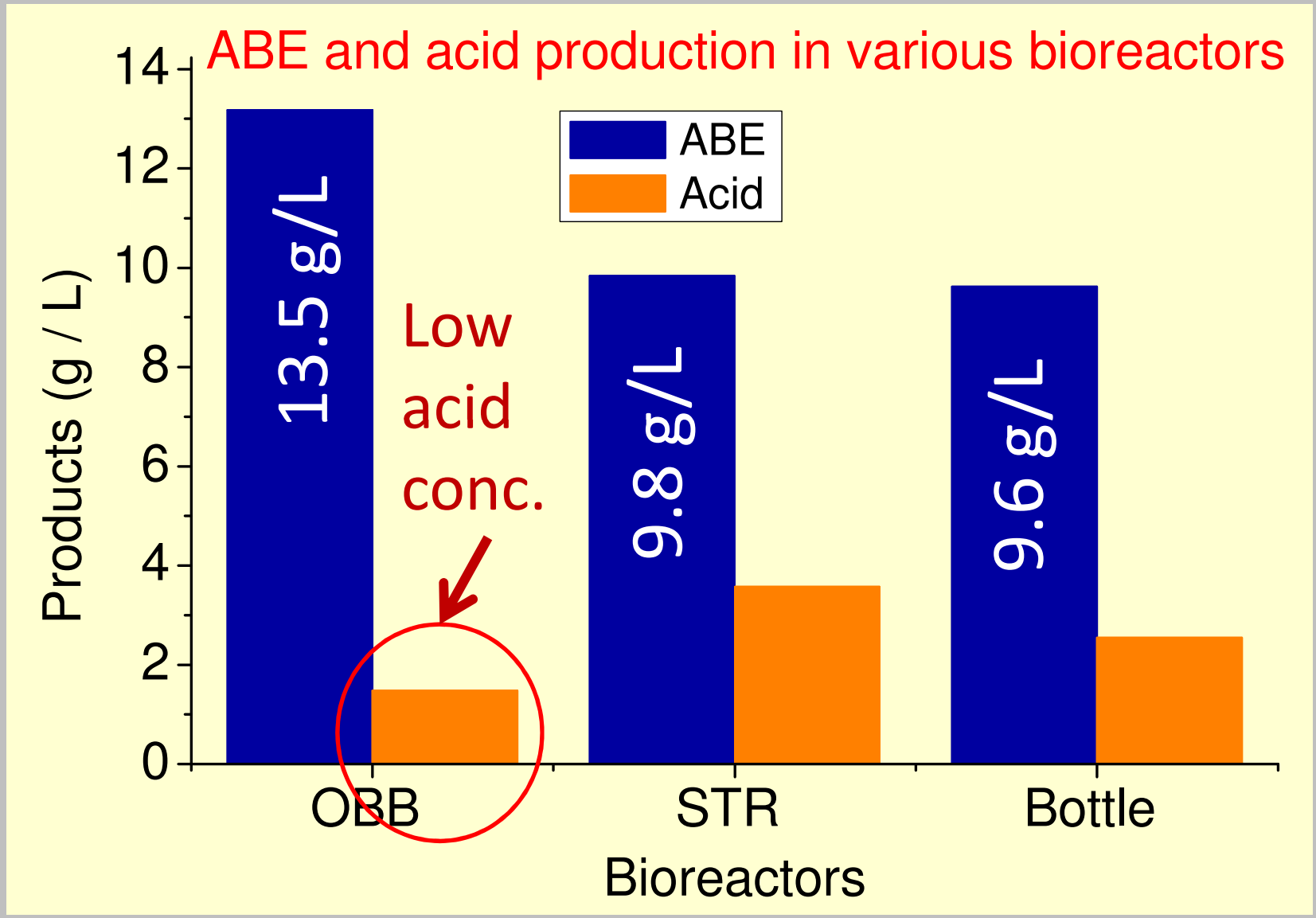
Ethanol

Fermentation condition:
Anaerobic
Temp. : 32^{o}C
pH$_{o}$: 6.5

Results


Yields and productivity in OBB at various Re_o
Yields
Productivity
Yields (g ABE/g glucose)
Productivity (g/L h)
0.44
0.40
0.36
0.32
0.28
0.24
0.20
0.16
0.12
Reo1870
Reo938
Reo470
OBB

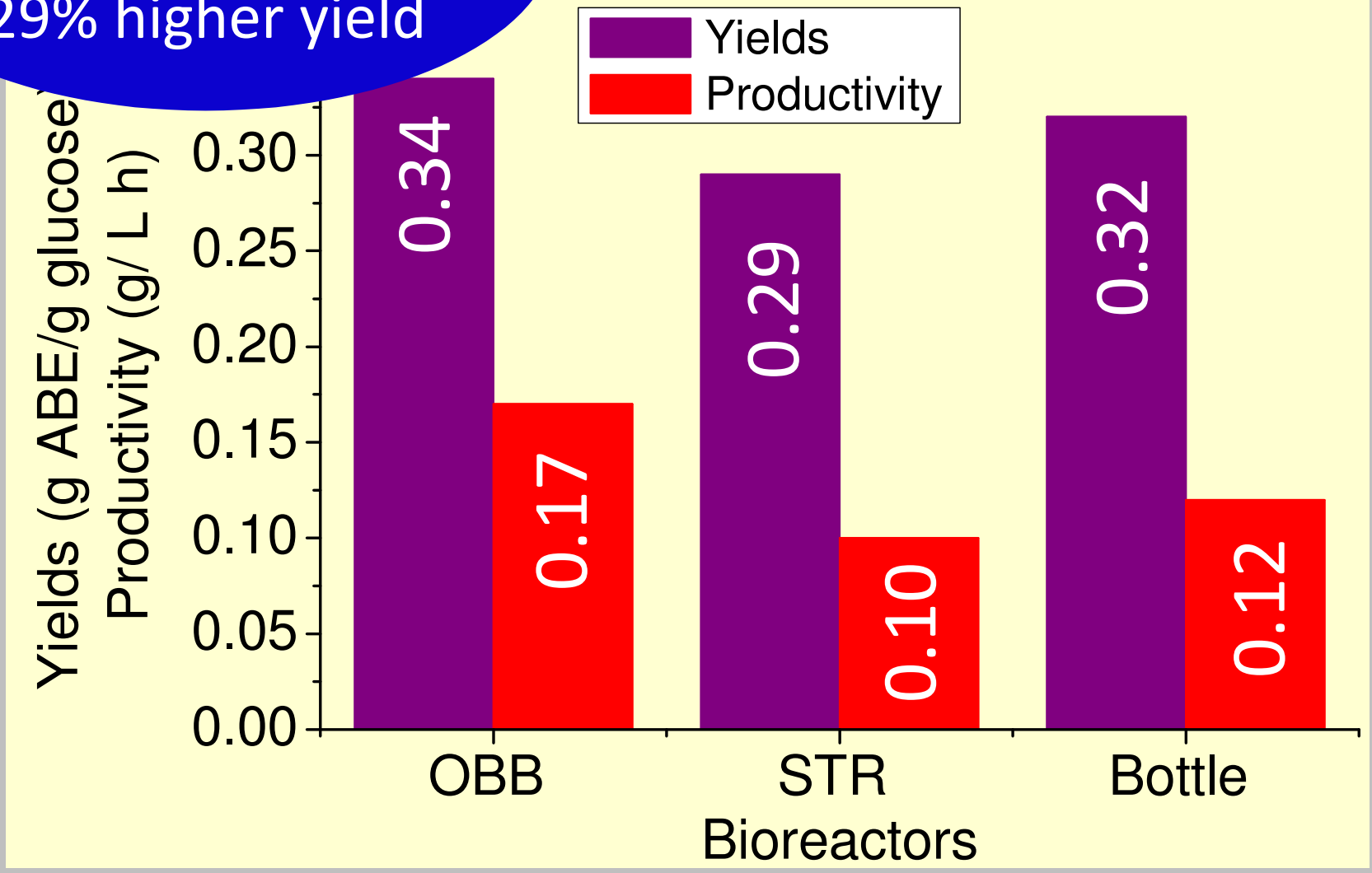
Results


ABE and acid production in various bioreactors
ABE
Acid
Products (g / L)
0
2
4
6
8
10
12
14
13.5 g/L
9.8 g/L
9.6 g/L
Low
acid
conc.
OBB
STR
Bottle
Bioreactors

Results

OBB:
6% greater yields
29% higher yield

oductivity in various bioreactors



Conclusion

- OBBs are advantageous reactor technology for biobutanol production: higher yield and productivity, reproducible at larger scale
- OBBs have lower peak acid – acid crashes are less likely
- Mixing independent over the range investigated so far – good yield at Re_o470; productivity at Re_o938

Thank you

- Technology Strategy Board (TSB)
- Dr Rosa Dominguez, Green Biologics Ltd, Oxford
- Ministry of Higher Education (MOHE), Malaysia