FERMENTO!

Making Oceans Out Of Droplets

Beer Fermentation Consumes Time… And this hurts

Production rate of beer is limited by the speed of fermentation and can be significantly enhanced by microfluidic fabrication

PAIN POINTS

- Fermentation is the longest step in the beer brewing process as yeast takes time to produce alcohol from sugar liquid in a batch reaction setting
- Time for fermentation = 3 weeks, compared to few hours taken for the rest of the brewing process
- Large costs around beer (especially lager) inventory tied up in the vats

OPPORTUNITY

- Problem prevalent across the **$520 Bn global market**, **growing at 6% CAGR**
- Craft beer in US, UK, Germany, Italy is a particularly attractive growing segment

OUR VALUE ADD

- Shorten the time taken for fermentation by 70%, from 21 days to 7 days, thus increasing overall alcohol production & profit potential
- **U-Penn enabled microfluidic fabrication technology** helps achieve industrial flow rates while maintaining alcohol quality and composition

Beer fermentation vats tie up significant inventory

Fermento Reduces Your Wait Time

Microscale droplet-makers – UPenn's IP – reduce fermentation time by keeping higher surface area of sugar liquid exposed to yeast at an industrially significant scale

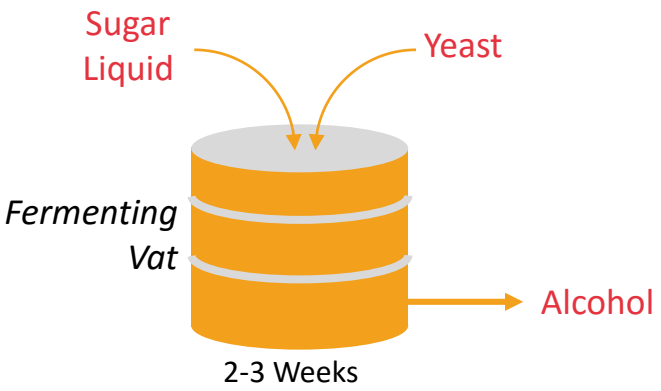
- **Current Process:** Prepared sugar-filled liquid is converted to alcohol, CO_2 & bi-products by yeast (a micro organism)
- Brewers use large vats (up to 250,000 liters) for this process ("fermentation")

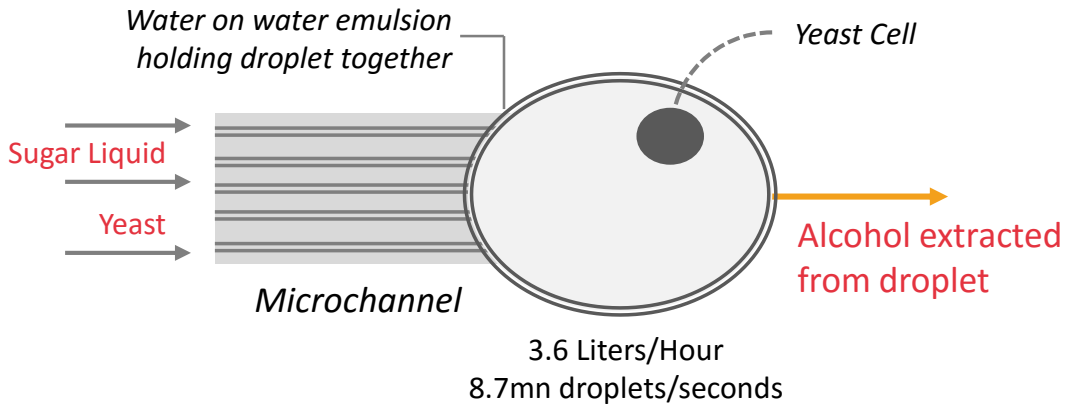
Our Technology: Penn's unique microscale droplet-maker technology improves fermentation time by 70%, using the same chemical process

Fermento's Value Proposition

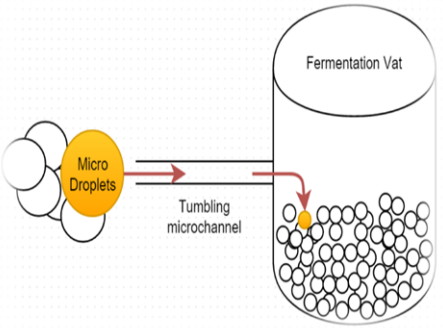
- **Low fementation time** (1 week) – by using droplets to concentrate sugar around yeast cells
- **Reusability of yeast cell** to save material costs
- **Greater alcohol production efficiency** -Since yeast cells are separated from each other by droplets, they are unspoilt by by-products
- **High throughput** of 3.6g/L-hrs compared to other microchannel processors – **can be scaled to industrial volumes using multiple pipes/channels**

Competition: (i) Batch reactors (**ii**) Immobilized fluid cell beds – Fermento is significantly faster than both





Fermentation in the micro-droplet



Fermento Process Flow

Making It Big: The Timeline

Phase 1: Year 1
ENTER

Crafting

- Scale up droplet maker
- Test installations, equipment
- Pilot with 4-5 microbreweries
- Pilot with 3-4 larger beer companies

Phase 2: Year 2-5
ESTABLISH

Horizontal Expansion

- Continue growth with beer companies & expand market across craft beer manufacturers
- Other revenue streams: **pharmaceuticals**

Phase 3: Year 5+
EXTEND

Product lines and Branding

- Enter into products requiring micro-surfaces for reaction rates
- Develop a global B2B brand for such critical product lines

Proof of concept - completed

- Ran 3 experiments using macro-droplets of an oil emulsion of a malt-based simple syrup with yeast
- Fermentation took place successfully - could separate the beer from emulsifying agents without issue

Next Steps – immediate future

- **Currently filing a provisional patent**
- Rent lab space, equipments and testing devices to produce beer using sugar microdroplets (MVP); talks on with U-Penn – expected total cost of USD 25k in the next 4 months
- **Pilot with beer cos** and microbrewers

Making It Big: Strong interest from global giants

In-principle approval to pilot Fermento from 6 global beer and biopharmaceutical clients

Pilot Clients

Marc Drucker,
Global Director –
Innovations & Ventures

Juan Carlos,
Technology Director

Rajiv Shetty,
Plant Director

Board of Advisors

Eric Wu,
Commercial Integration Lead,
MillerCoors

Eric Clemons,
Professor - Operations,
Wharton Business School

Jeremy Cohn,
Yeast Expert and CEO, Moody Tounge (*Brewery)*

Winners of Y-Prize competition (Mack Institute)

This is Us: The Three MuskeBeers

Siddharth Shah (COO)

Favorite Beer: N.A. (Teetotaler)

CEO @ SP Shah Consultants, UAE
CEO @ Frapee technologies, India
Product Development Manager @ Citibank
MBA @ Wharton
Bachelors of Technology @ IIT Bombay

Shashwata Narain (CEO)

Favorite Beer: Spotted Cow

Product Developer @ e-Logistics startup
Analyst @ Goldman Sachs, New York
Analyst@ Barclays Capital, New York
MBA @ Wharton
Applied Mathematics @ Yale

Alexander (CTO)

Favorite Beer: Blue Point

Publications in Bioengineering
Engineer at Hospital for Special Surgery
MS in Bioengineering @ Penn
Biomedical Engineering @ CCNY

THANK YOU

Special Mention

- **Heon Ho – Technical Consultant**
- **Mike Burns – Business Consultant**