



Improving Global Beer Quality Through Fermentation Control & Consistency

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Anheuser-Busch InBev



UNITED WE BREW™

Objectives

- Why Focus on Fermentation Control & Consistency?
- Practical Approach using DMAIC Methodology
- Managing Across Multiple Brewing Locations
- Q&A



Question: What % of a Beer's Flavor is Attributed to Fermentation vs. Brewhouse and Filtration?

Scan me!

Go to www.pigeonhole.at

Enter passcode

QXNYS3

Join Multiple-choice poll: **Fermentation Consistency**

SCREENS

- Sign-in instructions W
- ✓ Blank B
- ☰ Session title T
- ☰ Session description D
- ☰ Poll options O
- 👤 Session statistics I
- Back to chart Q

Sessions > Fermentation Consistency ^

Chart Type ^ Screens v



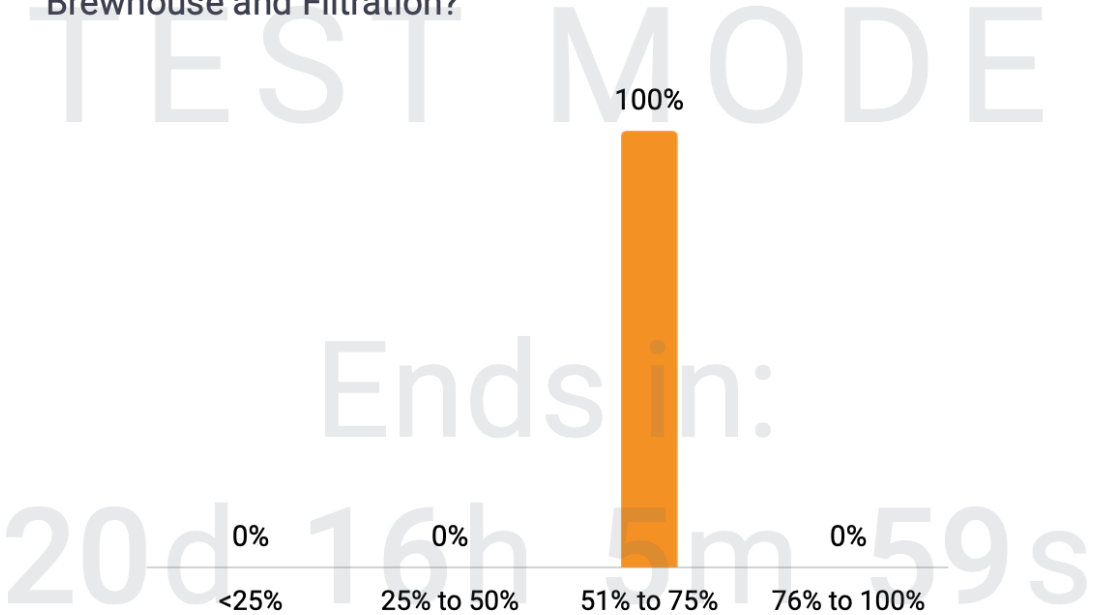
Question: What % of a Beer's Flavor is Attributed to Fermentation vs. Brewhouse and Filtration?

Pigeonhole^{Live} Go to www.pigeonhole.at/QXNYS3 to vote

Question 1 of 1

LIVE 1 participant | 1 vote

What % of a Beer's Flavor is Attributed to Fermentation vs. Brewhouse and Filtration?



Ends in:

20d 0% <25% 0% 25% to 50% 100% 51% to 75% 0% 76% to 100% 59s

Sessions > Fermentation Consistency ^

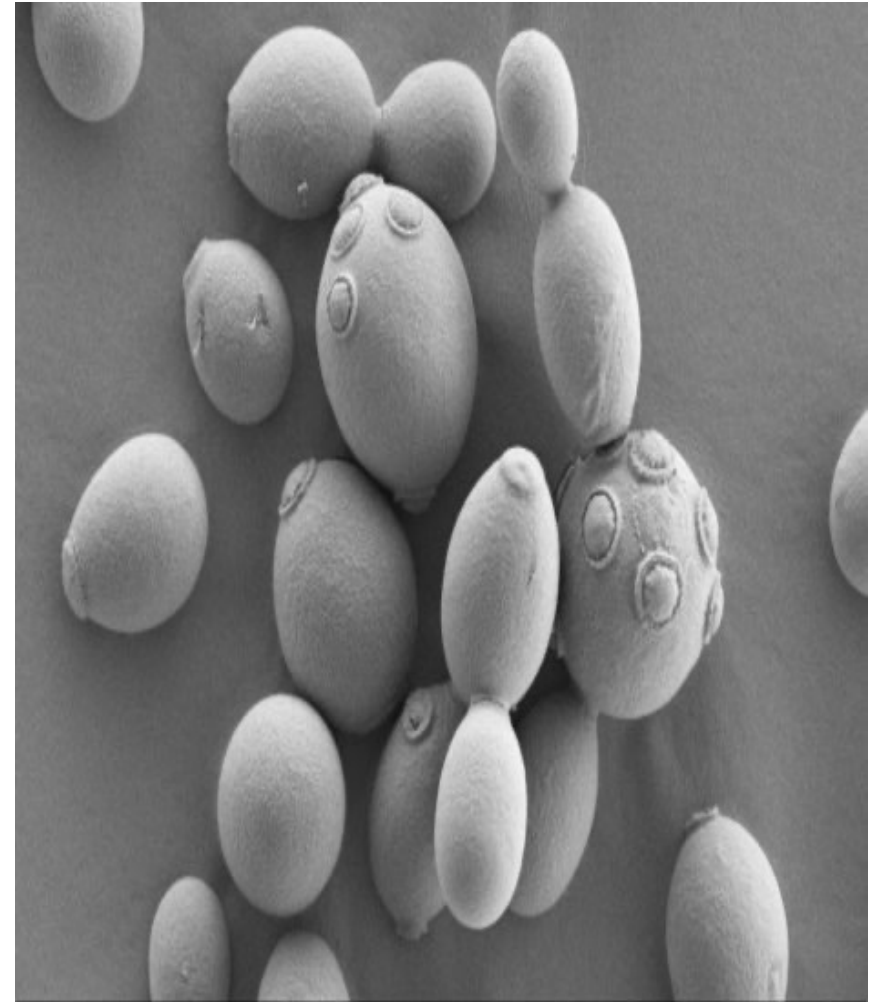
Chart Type ^ Screens ^



Why Focus on Fermentation Control & Consistency?

Significant impact on overall sensory perception

- **Aroma**
 - Alcohols, Sulfurs, Esters, VDK's, Aldehydes, etc.
- **Body/Mouthfeel**
 - CO₂, RDF, Attenuation, Astringency, pH
- **Appearance**
 - Foam, Haze, Particulates
- **Freshness & Flavor Stability**
 - Reduction of Carbonyls, SO₂



Why Focus on Fermentation Control & Consistency?

- **Operational Considerations**

- **Capacity**

- Overall Fermentation and Maturation Time
 - Fermenter Volume Utilization

- **Extract Recovery**

- Yeast Flocculation & Recovery
 - Over-foaming

- **Consistency and Repeatability**

- Single Brewery - Batch to Batch Consistency
 - Multiple Brewery – Brand Consistency
 - Ideal for Process Improvement and Optimization



Our Continuous Improvement Approach



Focus on
Fermentation
Consistency



Identify Main Drivers
of Fermentation
Performance



Keep it Simple –
Identify Critical Few
Process Drivers



Standardize
Engineering Design &
Implementation Plan



Must be “Frontline”
Understandable and
Monitored



Support with Full
Education & Training
to “Frontlines”.
Teach the “WHY”!



Leverage DMAIC
Methodology

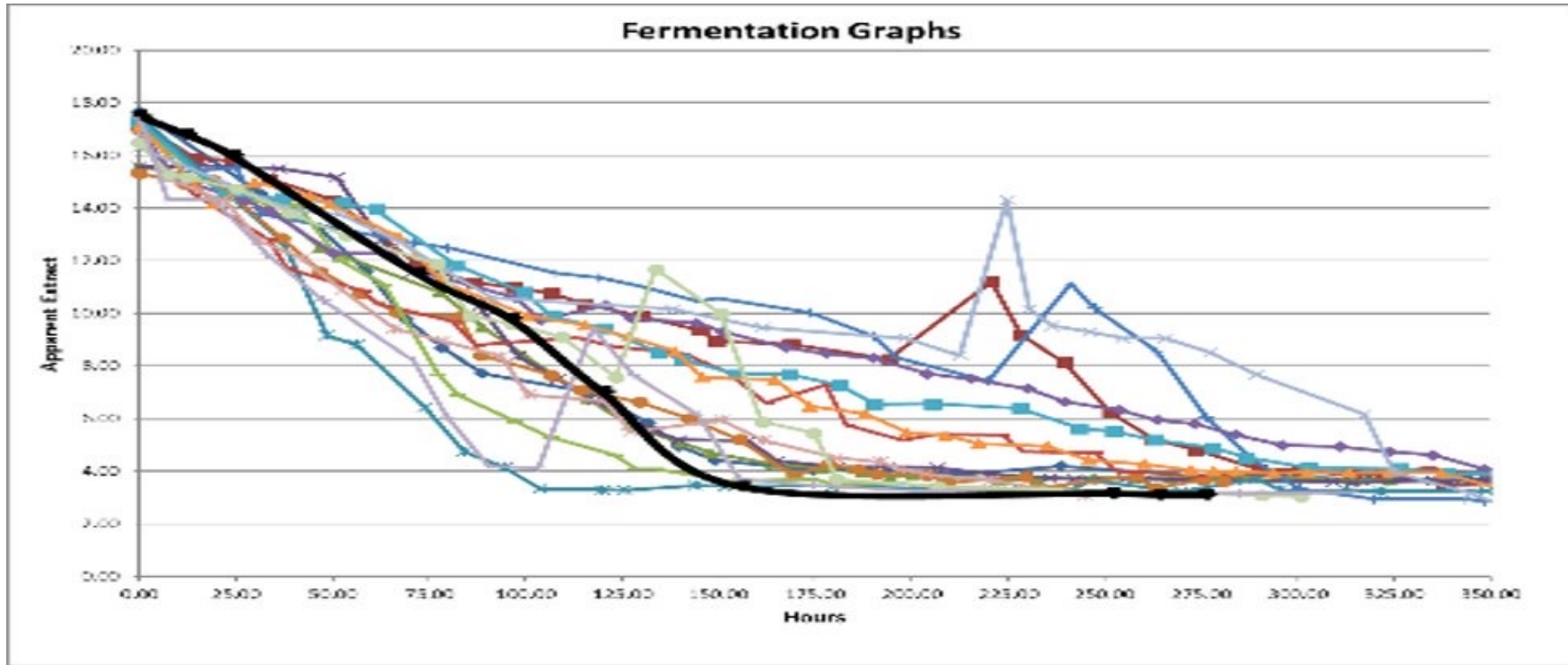


QUICK PRIMER ON DMAIC

- Lean Six Sigma Problem Solving Methodology
- More advanced form of PDCA (Plan, Do, Check, Act)
- D – Define
- M – Measure
- A – Analyze
- I – Improve
- C - Control



Define The Problem and Scope



Process
Variability

Lack of
Process
Control

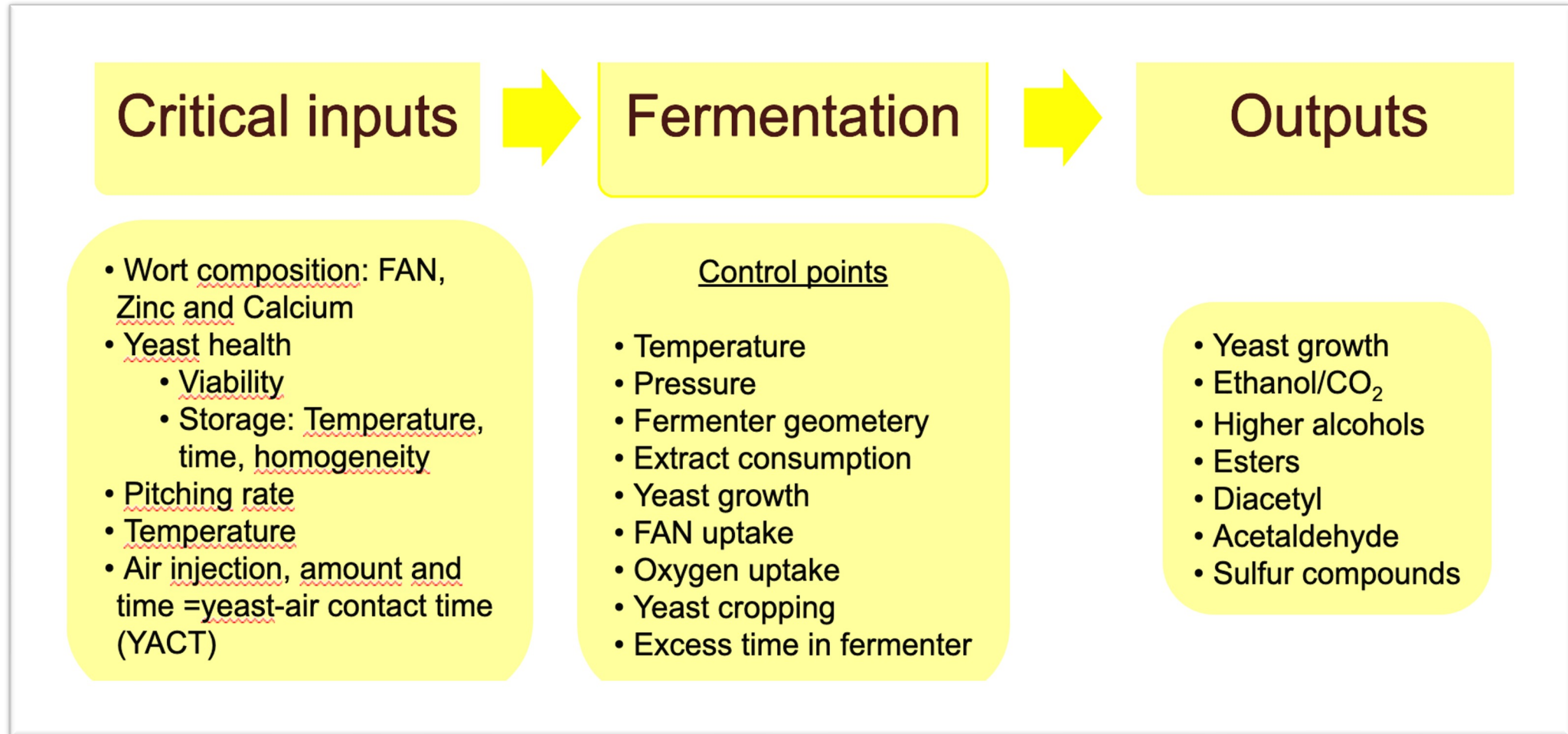
No
Standard
Tracking
and
Monitoring

Critical
Inputs &
Outputs
Not
Defined

Technical
Knowledge
Gap



Define The Problem and Scope (Key Drivers)



Define The Problem and Scope

Narrowed Focus Areas to Three Blocks to Improve Fermentation Consistency:

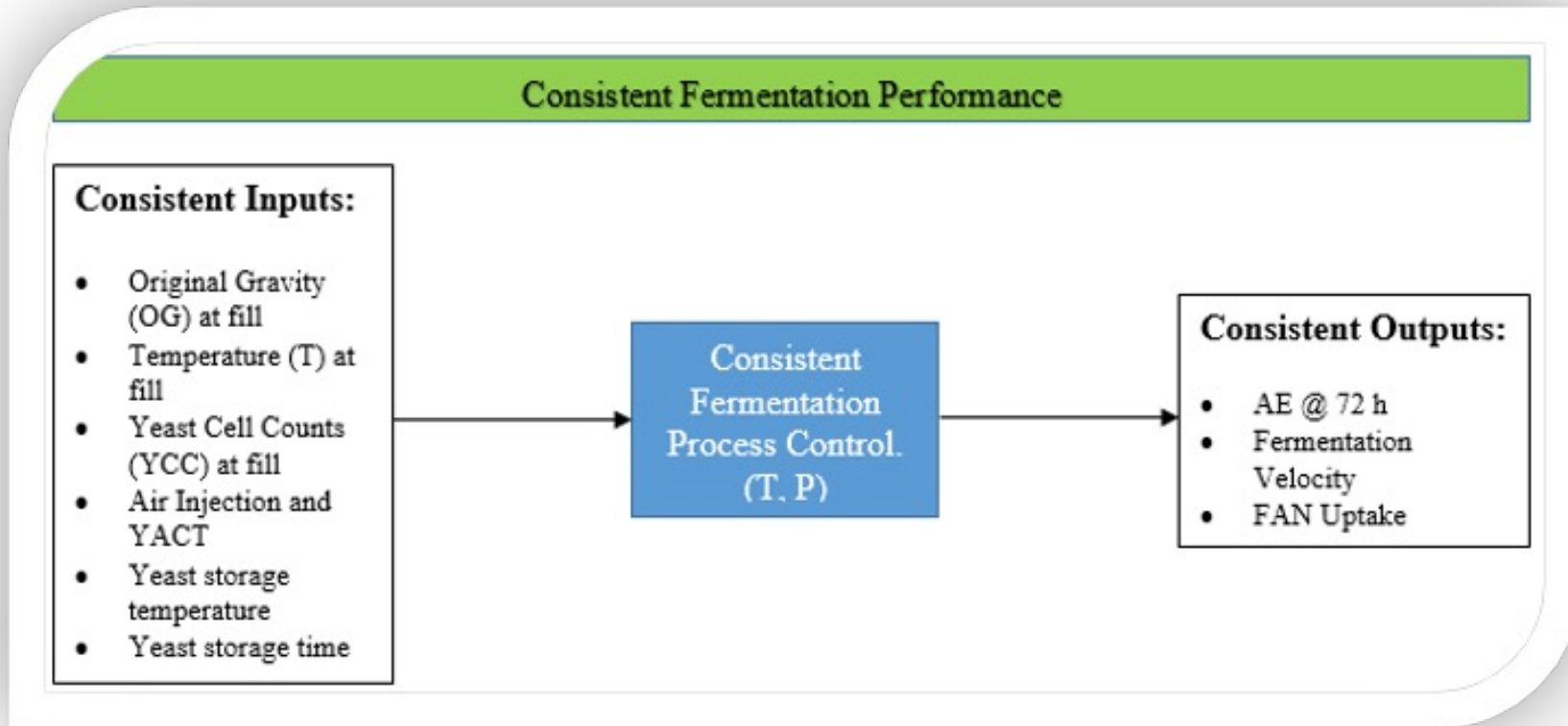
Technical
Knowledge

Minimum
Mandatory
Equipment

Fermentation
Consistency
Index

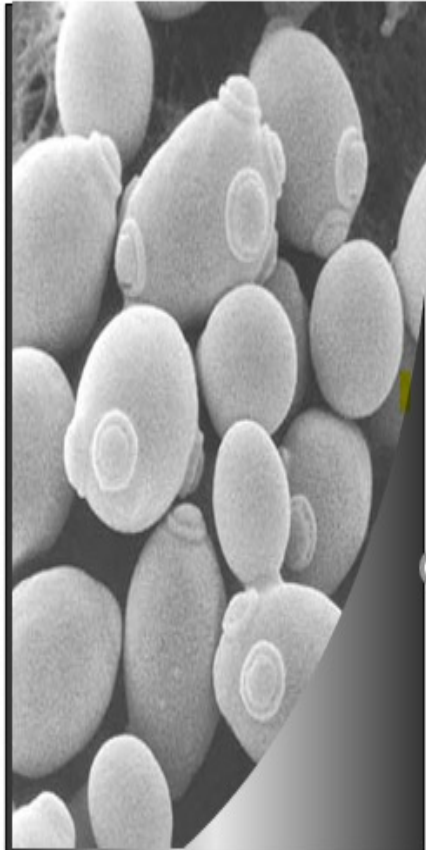


Measure – The Fermentation Consistency Index



- FCI developed to drive consistency in the fermentation process
- Process Indicators (PI's) within FCI are highly related to the brewer's involvement and basic understanding of the fermentation process.
- Only 2 PI's (YCC and FAN) requires laboratory support.
- FCI Policy, calculation tool and training material for brewers were developed.

Analyze – Global Consolidated FCI Scores



Fermentation Consistency Index Dashboard											
Zone	OG at fill	T at fill	YCC at fill	YACT	Yeast Storage Temp	Yeast Storage Time	AE @ 72hrs	Fermentation Velocity	FAN Uptake	FCI	Benchmark
Zone 1	86.03%	79.15%	3.98%	5.85%	48.55%	66.11%	55.53%	62.93%	75.00%	52.31%	100%
Zone 2	43.71%	35.08%	15.42%	7.83%	97.33%	89.25%	54.92%	56.25%	0.00%	40.37%	100%
Zone 3	37.67%	34.00%	0.00%	0.00%	21.00%	100.00%	20.00%	54.33%	17.67%	31.63%	100%
Zone 4	35.60%	29.90%	12.65%	6.94%	34.33%	77.16%	40.07%	73.31%	83.84%	43.93%	100%
Zone 5	89.18%	63.21%	9.28%	6.97%	59.71%	98.19%	63.10%	62.56%	65.40%	55.30%	100%
Zone 6	44.42%	63.48%	7.65%	8.03%	71.47%	87.36%	22.53%	54.62%	46.69%	40.50%	100%
Global	56.10%	50.80%	8.16%	5.94%	55.40%	86.35%	42.69%	60.67%	48.10%	44.01%	100%

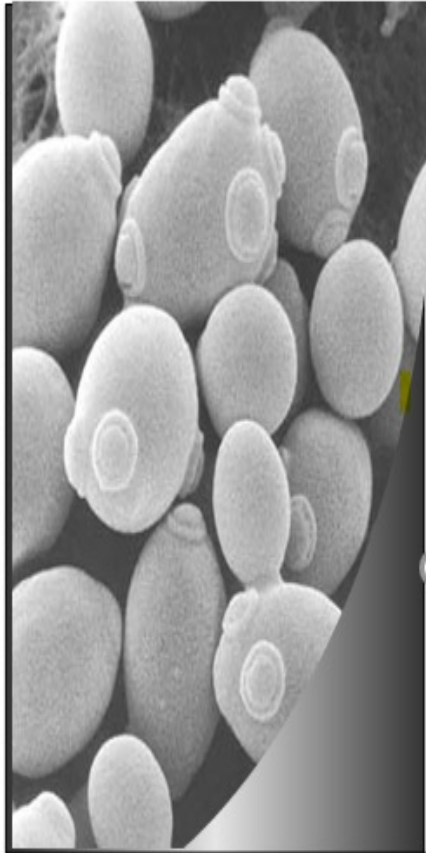
FCI calculation:

Fermentor No	Brand	OG at Fill (10%)	T at Fill (10%)	YCC at fill (10%)	Air Injection & YACT (15%)	Yeast storage Temp. (10%)	Yeast Storage time (10%)	AE@ 72 h (10%)	Fermentation Velocity (10%)	FAN Uptake (15%)	FCI (%)
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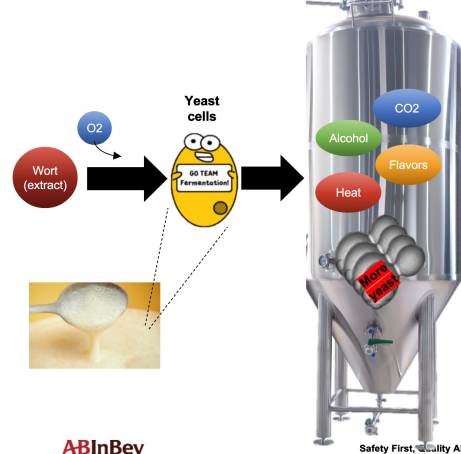
- **Results confirm initial predictions!**
- **2 critical control points - Air injection control, Pitching rate and yeast growth are the biggest gap.**
- **4 control points – OG at fill, T at fill, Yeast storage temp and Yeast storage time do not require capex and are simple to correct.**



Improve – Increase Technical Knowledge



What is Fermentation?



Air (oxygen) is added to wort from brewhouse

Yeast is added to the aerated wort

At the start of the fermentation, yeast takes up first the oxygen

Then yeast consumes the extract in several days and the magic happens, wort becomes beer!

Yeast produces during this time also:

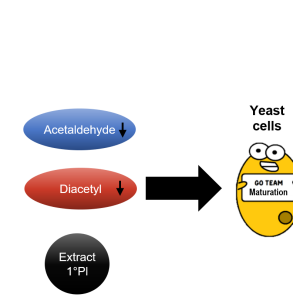
- More yeast (yeast grows)
- CO2
- Alcohol
- Beer flavors

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Safety First, Quality Always, VPO/DPO Forever!

DPO VPO

What is Warm Maturation?



The warm maturation is the phase after the main fermentation, when only small amount of extract is left

During the warm maturation, unwanted flavours as Diacetyl and Acetaldehyde are removed from the beer by yeast

Fermentation and warm maturation happens usually in the same vessel. Sometimes it is done in 2 separate vessels

It takes several days to remove enough Diacetyl

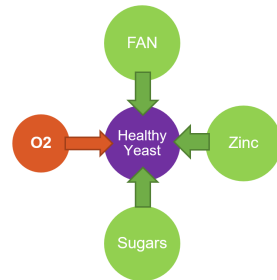
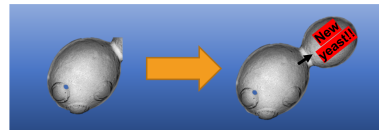
A lower pH speeds up the diacetyl reduction!
This is mainly controlled by the wort pH.

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DPO VPO

Yeast Growth



To have good yeast growth during the main fermentation, 3 things are important

1. The added yeast must be healthy:
 - Recovered on time from FV (see brand spec)
 - Storage of less than 72hrs before addition
 - Stored between 1 and 3°C
2. Wort must contain sufficient minerals (Zinc) and Amino Acids (FAN)
3. There must be sufficient oxygen available

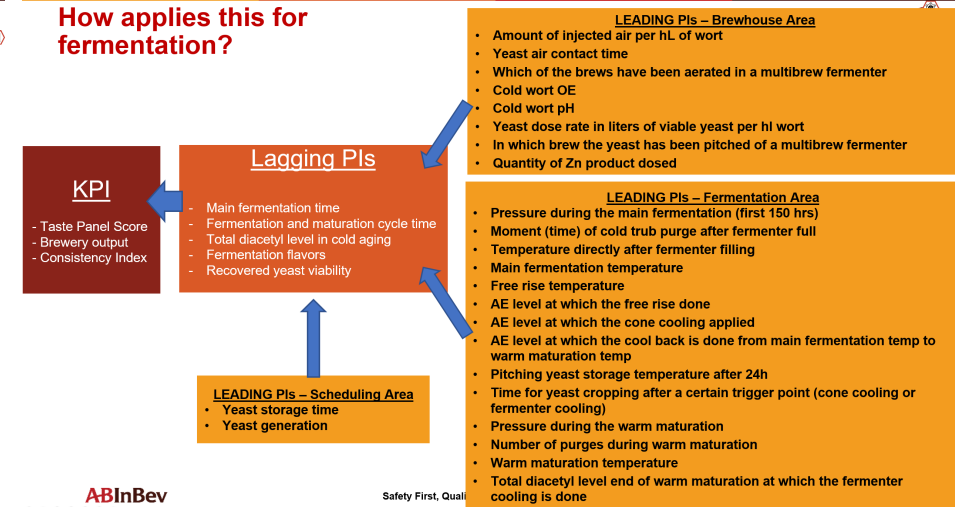
The amount of yeast growth is in practice fine-tuned by controlling the amount of added oxygen. This is done by the air injection system.

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Safety First, Quality Always, VPO/DPO Forever!

DPO VPO

How applies this for fermentation?



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Safety First, Quality Always, VPO/DPO Forever!



Improve: FCI | Implementation Example – Middle America Zone

KPI Cascade → Global Team
Dec21

Level 2
VPO Quality Pillar
ABInBev
Original Date: 21 DEC 2021
Revision Date: 21 ENE 2022
Version #: 1.0
Page 1 of 9
Confidential – Proprietary
Information AB-InBev
Owner: Global Quality Director
Approved: Global BSG

INDICE DE CONSISTENCIA DE FERMENTACION (FCI)

1. PROPOSITO

FCI fue desarrollado para impulsar la mejora de la consistencia en el proceso de fermentación a través de la evaluación de cumplimiento de un número definido de indicadores de proceso que se enfocan en la premisa de que las entradas consistentes y el control constante del proceso de fermentación proporcionaran resultados consistentes y un desempeño sensorial consistente.

Los IPI considerados en el FCI están relacionados con la interacción directa de los operadores con el proceso de fermentación y solo un par de ellos (VCC y FAN) requerirán apoyo de laboratorio. Por lo tanto, el desempeño de FCI está altamente relacionado con la participación de los operadores y la comprensión general del proceso de fermentación. Para respaldar este último y como parte de esta política, se desarrolló material de capacitación para explicar el proceso de fermentación y la importancia de lograr insumos consistentes, un control constante del proceso de fermentación para lograr resultados consistentes.

Performance de Fermentación Consistente

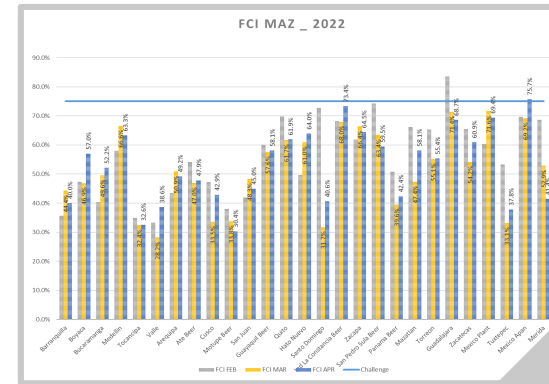
```

    graph LR
      subgraph Entradas
        E1[Entrada Original (EO)]
        E2[Controlador Linea]
        E3[Temperatura (T)]
        E4[Flujo de línea de fermentación (VCC)]
        E5[Sensibilidad línea YAC]
        E6[Sensibilidad de línea y YAC]
        E7[Temperatura de almacenamiento de insumos]
        E8[Tiempo de almacenamiento de insumos]
      end
      subgraph Salidas
        S1[EA @ T2]
        S2[Viscosidad de fermentación]
        S3[Atribución del FAN]
      end
      subgraph Control
        C[Control consistente del Proceso de Fermentación (T, P)]
      end
      Entradas --> Control
      Control --> Salidas
  
```

GBQ181-183-APP2-Fermentation Consistency Index Template

Barra de búsqueda: BARRA DE BÚSQUEDA

Plantilla de Excel con columnas de Yes/No y pestañas: Plantilla Español, Template, Template by P...



MAZ report started
Feb22

Workshop B&Q:
Reinforcement with breweries
Apr22

Cascade meetings with MAZ Regions

MAZ: Excel template for calculation

Feedback Meeting with Global: concepts and calculations



Improve: FCI | Cascade to Breweries

FCI – Fe

Se repor

Cada IP específico

1. Extrac
2. Temp
3. Recue
4. Inyec

FCI Definición

1. EO – FV Llen

- EO promedio de lo
- Frecuencia: Cada
- Criterios de cumpli

2. TEMP – FV L

- Temperatura toma
- Frecuencia: Cada
- Criterios de cumpli

FCI Definición

3. Recuento de

- 3 Condiciones obli

1. Sistema AB
2. Auditoría de (semanal po
3. Resultado d

El sistema garantizar

FCI Definición

4. Inyección de

- 3 Condiciones obli

1. Dos medic <5% entre a
2. Tasa de iny automático
3. YACT Target

• YACT se define d mosto aireado has

FCI Definición

5. Temperatura

- Temperatura de a inoculación del fer
- Frecuencia: Cada
- Criterios de cumpli

6. Tiempo de a

- Tiempo de almada (Estandarizar med
- Frecuencia: Cada
- Criterios de cumpli

FCI Definición

7. Extracto Apa

- Valor de extracto a (usar interpolaci
- Frecuencia: Cada
- Criterios de cumpli

8. Velocidad de

- Tiempo desde llen
- Frecuencia: Cada
- Criterios de cumpli

FCI Definición

9. Asimilación de FAN (FAN Uptake) – 15%

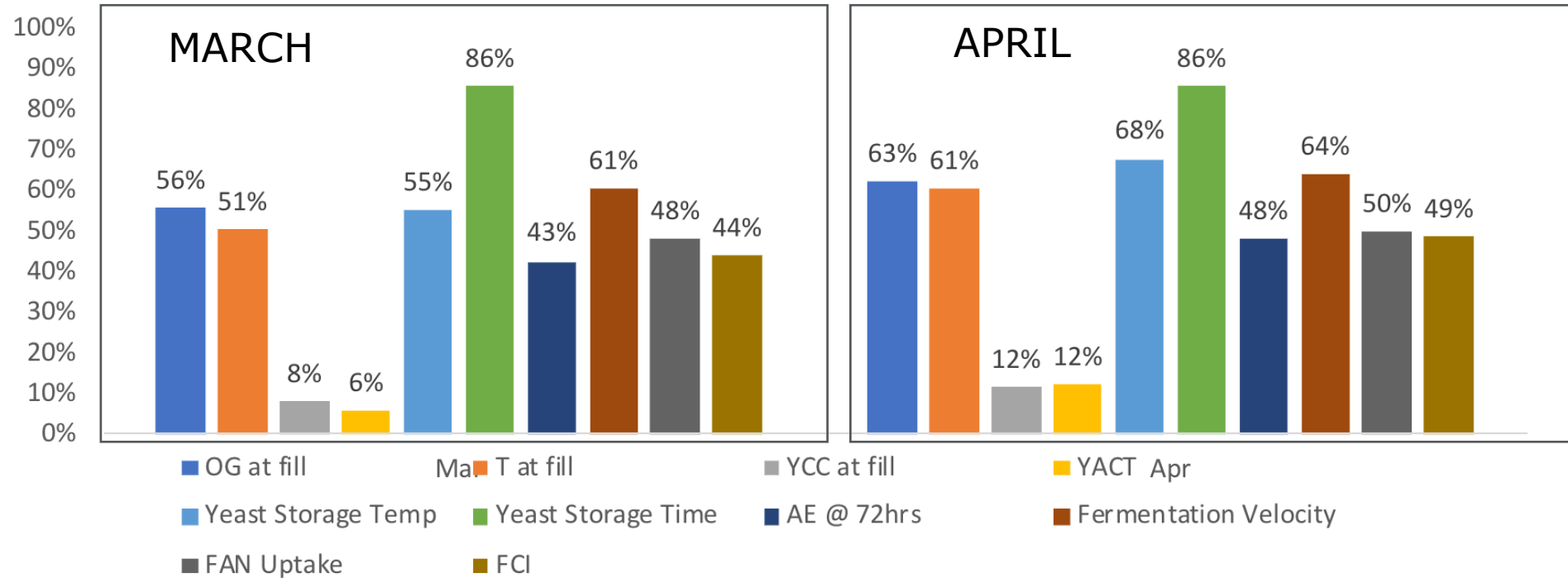
- FAN Uptalke = FAN en el mosto al inicio de Fermentación - FAN de la cerveza al final de Fermentación.
 - ✓ El FAN del mosto = muestra compuesta de los cocimientos que llenaron el fermentador..
- Frecuencia: 1 fermentador / marca / semana. (este valor se debe colocar en todos los FV de cada marca de esa semana)
- Criterios de cumplimiento: > 90 ppm y dentro del rango de especificación de asimilación de FAN de la marca.
- El amino nitrógeno libre (FAN) es el producto resultante de la descomposición de péptidos y proteínas, generalmente suministrado por la cebada malteada. Los niveles de FAN en el mosto son definidos por la marca/receta.

FAN Uptake = Crecimiento levadura = Rendimiento Fermentación = desarrollo perfil sensorial



Control: Tracking & Monitoring

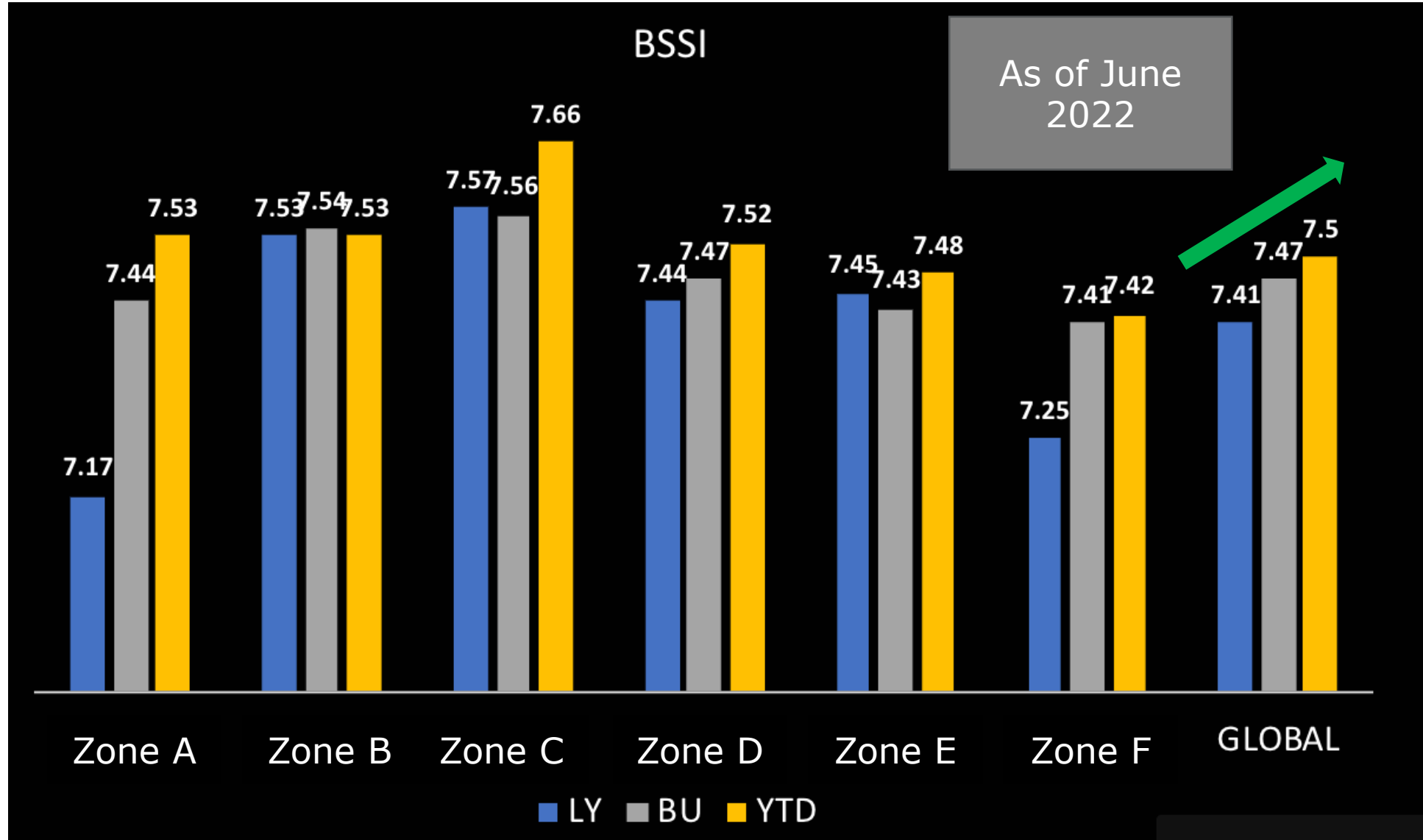
Fermentation Consistency Index



Improvement in 3 Parameters:
OG at Fill, Temp at Fill, and Yeast Storage Temperatures



Results: Global Beer Sensory Scores Improving!



Key Take-Aways

- Leverage Sensory Program to Drive Continuous Improvement
- Consistent Inputs + Consistent Outputs = Consistent Fermentations
- Technical Knowledge + Define Equipment + Standardize How to Measure
- Utilize Proven Problem Solving Methodologies – DMAIC
- Tracking and Monitoring Process Indicators (PI's) is critical for “Control” and Continuous Improvement
- Keep it Simple and Understandable
- Be Sure Teams Understand the “Why” Behind the “PI's”



Resources

- Contact info: Kristopher.Scholl@AB-InBev.com



CHEERS!

Thank You



Q & A

