Yeast Selection for Beer Diversity
I Introduction - Our Group and Fermentis
II Yeast Production and Product Usage
III Yeast Characteristics/Selection
   - attenuation
   - kinetics
   - flocculation
   - flavours
IV Example of yeast selection - Belgian Copper/Blonde
Consolidated annual sales revenue
- > 1.5 billion Euro.

Global presence
- ~ 8,000 employees around the world
- ~ 50 manufacturing sites worldwide
Be a vector of innovations.

180 researchers
160 years of expertise and know-how
60 partners universities and research centers around the world

Radiate internationally

180 countries where products and services are marketed
50 production plants operating in over 40 countries
70 nationalities represented

Commit for the environment

15% of all industrial and technical investments are devoted to the environment
Business Unit in charge of development, marketing and sales of innovative and qualitative products and services for/to the beer, wine, spirits and all other potable alcohol industries worldwide.
II YEAST PRODUCTION AND USAGE
- Pure cultured yeast
- Propagated in dedicated state-of-the-art facilities.
- Grown on a balanced nutrient based on sugar derivates
- Batch fed
- Fully aerobic conditions are used to maintain maximum yeast growth.
II Yeast Production – Membrane Risk

- **Hydrated**
  - Full size
  - Fluid

- **Drying**
  - Size reduction
  - Folding

- **Dry**
  - Partially crystalline
  - Endo vesicle
  - Rigid
Objective of maximum yeast membrane recovery in rehydration – how?
Trehalose and membrane stability

Without

With

Leakage

Low leakage

Drying

Hydration
Continuous batch control/piloting culture

Yeast duplication in the fermentor

Migration

Replication

Spindel

Segregations

Division

Cytokines

Ready to start

“Doors” are open for sugar assimilation

Glucose

Maltose

Glucose

Maltose

Stabilised membrane

Active dry yeast

Yeast Shaping

Max. Vitality
II Easy to Use - Rehydration

Sprinkle yeast in **10 times** its weight in water or wort

Gentle Agitation

Let rest 30mn

Pitch yeast by transferring to fermenter

Yeast Rehydration

Ale 25-29°C

Lager 21-25°C
<table>
<thead>
<tr>
<th>Rehydrated Yeast Temperature</th>
<th>Maximum Hold Time</th>
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<tbody>
<tr>
<td>4 ° C</td>
<td>18 h</td>
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<tr>
<td>20 ° C</td>
<td>6 h</td>
</tr>
<tr>
<td>25 ° C</td>
<td>4 h</td>
</tr>
</tbody>
</table>
1/ Fill CCT with wort 21 - 29° C (Lager or Ale range)

2/ Sprinkle yeast directly on wort surface in CCT

3/ Fill fermenter with wort at fermentation temperature
Modification made to wort line, just after O2 addition

Connect CO2 pressure here for counter pressure

No pressure fills with wort

Under pressure to pitch

When pressure falls while pitching

Refill a second time to ensure all yeast is pitched

Connect «hose to main wort line» here

For wort in and wort+ yeast out
Solutions for all scales

Available Technology for Craft as well as Industrial Breweries
- Size 2.4 HL/10 kg Fermentis Yeast Sachet [10 kg] → 100 HL Lager to 200 HL (Ale Beer) fermenter
- Touch screen control panel
- Stainless Steel AISI 316
- No welded elbows
- Agitation type recyclying/whirlpool
- Centrifugal pump [to pitch into up to 3 bar counter pressure]
- CIP preparation tank and CIP spray ball
Phase F1 – Tank Fill
- Yeast/liquid ratio [volumetric flow meter of rehydration liquid]
- Temperature

Phase F2 – Rehydration
- Add Yeast
- Rehydration time
- Circulation Rate/Agitation
- Aeration (on/off)

Phase F3 – Pitch Fermenter(s)
- 100% transfer or Dosage (or Split Cream for sequential pitch)
III YEAST CHARACTERISTICS / SELECTION

- Attenuation
- Kinetics
- Flocculation
- Flavours
III Characteristics - Ale strains

Fermentation kinetics
Process Time

18°C, 20°C

Apparent Attenuation %

Days

0 2 4 6 8 10 12 14 16 18 20

0% 10% 20% 30% 40% 50% 60% 70% 80% 90%

Safbrew WB-06
Safbrew S-33
Safbrew T-58
Safbrew BE-256
Safbrew K-97
Safale US-05
Safale S-04

6 days 10 days

6 days
256
III Yeast Characteristics - Lager strains

13.5°F, 48 h @ 12°C followed by 14°C

Apparent Attenuation %

Days

Saflager W34/70
Saflager S189
Saflager S23
III Characteristics – Attenuation

Fermentation kinetics
Process Time
III Characteristic - Attenuation

- Glucose
- Maltose
- Maltotriose
- Melibiose
### III Characteristics – Attenuation

#### Attenuation (%)

<table>
<thead>
<tr>
<th>Yeast/Malt</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
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<tbody>
<tr>
<td>W34/70</td>
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### Residual Maltotriose (g/l) (18°P EBC tubes)

<table>
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<tr>
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<th>0.0</th>
<th>2.0</th>
<th>4.1</th>
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III Characteristics
– OG effect on Resid. Maltotriose

[Graph showing the relationship between Original Gravity (°P) and Maltotriose g/l for two strains: W34/70 and T58.]
Fermentation kinetics Process Time

III Characteristics – Final Gravity

Apparent Attenuation %

Safbrew WB-06
Safbrew S-33
Safbrew T-58
Safbrew BE-256
Safbrew K-97
Safale US-05
Safale S-04

18°P, 20°C

Days

0 2 4 6 8 10 12 14 16 18 20

6 days 10 days
III Characteristics – Fermentation Kinetics

Reaching FG is strain/process specific
Fermentation time will increase exponentially with increase of original gravity
III Characteristics - Alcohol tolerance

% maximal alcohol achieved in the trials (EBC tubes)

- W34/70 (Saflager)
- S23
- S189
- K97
- US05 (Safale)
- S04
- WB06
- S33 (Safrés)
- T58
- BE-256

Values:
- 6.00
- 6.50
- 7.00
- 7.50
- 8.00
- 8.50
- 9.00
- 9.50
- 10.00
- 10.50
- 11.00
- 11.50

BE - 256 has the highest alcohol tolerance.
III Characteristics - Alcohol Limit

Final Ethanol and residual sugars depending on the original gravity (T58)
The yeast flocculation can be defined as a non-sexual phenomenon, homotypic (between similar biological structures), reversible and multivalent aggregation of yeast cells in a multicellular mass (see consisting of thousands of millions of cells) called "floc", with the consequent effect of sediment rapidly or in the medium they are suspended.

The cells with the capacity formed floc are said flocculent and look like tufts of wool, while those who do not have this capacity are generally called powdery.

III Characteristics - Sedimentation

Sedimentation speed (Helm’s test floculation)

K-97 (+)
WB-06 (-)
US-05 (+-)
T-58 (-)
S-33 (-)
BE-256 (+)
S-04 (+)
S-23 (+)
S-189 (+)
W-34/70 (+)
III Characteristics - Flavours

Beer Composition Analysis

Beer Sensory Analysis
III Characteristics - Flavours

Total Esters (ppm) = Ethylacetate + Isoamylacetate

Total Higher Alcohols (ppm) = Propanol + Isobutanol + Isoamylalcohol
Belgian Copper/Blonde

This ale aims to be at 6.5% v/v very refreshing, well attenuated for drinkability with significant fruit and some spiciness from fermentation. The brewery has no issue with process times; long fermentations and process time are possible.
Belgian Copper/Blonde

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**Example of Yeast Selection**

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<tr>
<th>Apparent Attenuation</th>
<th>Alcohol Tolerance</th>
<th>Sedimentation</th>
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</thead>
<tbody>
<tr>
<td>WB-06</td>
<td>W-34/70</td>
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<td>WB-06</td>
<td>US-05</td>
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<tr>
<td>T-58</td>
<td>K-97</td>
<td>S-33</td>
</tr>
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**WB-06, BE-256, K-97, US-05**
Belgian Copper/Blonde

This ale aims to be at 6.5% v/v very refreshing, well attenuated for drinkability with significant fruit and some spiciness from fermentation. The brewery has no issue with process times; long fermentations and process time are possible.

**Flavor information**

<table>
<thead>
<tr>
<th></th>
<th>fruity</th>
<th>neutral</th>
<th>floral</th>
<th>spicy</th>
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<tbody>
<tr>
<td>S-04</td>
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<td>K-97</td>
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**WB-06, BE-256, K-97, US-05**
Belgian Copper/Blonde

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### IV Example of Yeast Selection

#### Physicochemical characteristics

<table>
<thead>
<tr>
<th>Alcohol Tolerance</th>
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<th>Appearance</th>
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<td>T-48</td>
<td>T-48</td>
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</tbody>
</table>

#### Flavor information

- The flavor produced by yeast depends on process parameters. By example, one gravity beer fermented with SafAle® S-04 can be mainly fruity but high gravity beers are mainly neutral. The reference is obvious with SafAle® K-97.

#### Type of Beer | Organoleptic Characteristics | Yeast suggested
--- | --- | ---
Weissen | White to Amber, Hazy, wheat base, phenolic, citrusy | WB-06
Blanche | White, Hazy, wheat base, refreshing, spicy, citrusy | WB-06, T-58, K-07
Pils | Lager beer, blond to golden, brilliant, refreshing, drinkable, slightly crispy, medium bitterness, highly digestable, neutral, malty or gently fruity | W-34/70, S-189, S-23
Session | Blond, light body and dry, low alcohol, hoppy, high drinkability | K-97
Kölsch | Blond, palatable, low alcohol, low bitterness, gently fruity | S-04, BE-256, US-05
IPA | Blond to amber, dry and hoppy (bitter and aromatic) | S-04, BE-256, US-05
Triplo | Blond to golden/amber, high alcohol, malty, fruity, full body, roundness | S-04, BE-256, S-189, K-07
Saison | Blond to amber, refreshing, very dry, low alcohol, gently acidic and yeasty, hoppy, gently saturated | K-97, WB-06
Bitter | Blond to amber, medium body and residual sweetness balanced with high bitterness, hop character | S-33, S-04, US-05
Ales (Pale/Amber/Brown) | Blond to brown, medium alcohol content, fruity (estery), more or less malty tastes & notes, nutty, caramel | S-04, BE-256, US-05
Double | Amber - Brown/Dark, high alcohol, malty, fruity, caramel, licorice, body & roundness | S-33, S-04
Scotch | Amber to brown, full bodied, malty and lightly hopped | S-33, S-04
Barley wine | Amber - Brown, woody, slightly saturated, maderized, stewed fruit | S-33, T-56, BE-256, K-97
Porter | Milk to dark brown with red tint, roast malt flavor and aroma, sweet to bitter flavor, medium body, nutty esters | S-04, BE-256, US-05
Stout | Dark, creamy, smooth body, chocolate, coffee, roasted | S-33, S-04
Imperial Stout | Dark, high alcohol, hot mouthfeel, chocolate, coffee, roasted | T-58, US-05
Cheers!

Contact
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E-mail:jpitt.fermentis@lesaffre.fr