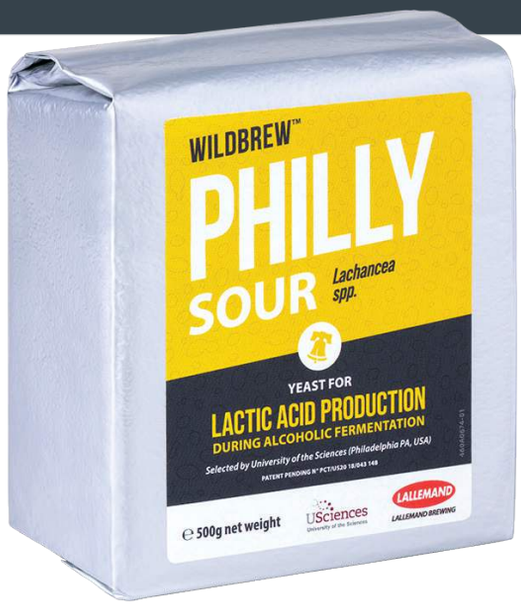
WILDBREW PHILLY SOUR™ BREWING

WildBrew Philly Sour™ is a unique species of *Lachancea* selected from nature by University of the Sciences in Philadelphia, PA, USA (Patent pending N° PCT/US20 18/043 148). **WildBrew Philly Sour™** produces moderate amounts of lactic acid in addition to ethanol in one simple fermentation step. This first yeast in the **WildBrew™ series** is a great choice for innovative, sessionable sour beers with refreshing acidity and notes of stone fruit.

WildBrew Philly Sour™ fermentation performance depends on a variety of factors within the individual brewers environment.



FERMENTATION TIPS

1. LACTIC ACID MANAGEMENT

The level of lactic acid obtained is controlled by the amount of glucose in the wort.

- **Glucose levels can be controlled by:**
  1 › Mash temperature (where a higher mash temperature creates less lactic acid, a lower mash temperature creates more).
  2 › Use of glucose-based adjuncts (ex. dextrose).
  3 › Grain bill where the use of more specialty malts creates less lactic acid and the use of more highly modified malts creates more.

2. SECONDARY YEAST

- **If a secondary yeast will be used, it should be added midway through fermentation to avoid competition for simple sugars.**

3. FRUIT

The timing of fruit additions will affect the amount of lactic acid produced.

› Fruit added in the first 24-48hrs of fermentation will increase lactic acid production due to the presence of more glucose.

› Fruit added midway through fermentation (2-4 days) will increase attenuation without significantly increasing lactic acid production.

› Fruit added after active fermentation has finished may result in incomplete fermentation. **WildBrew Philly Sour™** is highly flocculant and may not efficiently metabolize late sugar additions.

4. REPITCHING AND BOTTLE CONDITIONING

› Repitching is not recommended due to inconsistent results. Lactic acid levels may be lower or absent in re-pitched fermentations. However, **WildBrew Philly Sour™** performs well when propagated by combining multiple brews into one fermenter.

› Bottle Conditioning with **WildBrew Philly Sour™** is not recommended since the priming sugar will be converted into both lactic acid and ethanol, so levels of lactic acid, ethanol and CO_2 in the beer may be inconsistent. For best results, use a separate strain such as LalBrew CBC-1 to bottle condition **WildBrew Philly Sour™** fermentations.

FERMENTATION KINETICS

- **Lactic acid is being created from glucose within the first 24-72 hours of fermentation**
  › Apparent wort density does not significantly drop during the lactic production phase.
  › Very little CO_2 production occurs during this stage
  › Ethanol production will typically begin 24 hours after pitching.
- **Wildbrew Philly Sour™ benefits from high fermentation temperatures (22 - 30°C)**
  › A higher fermentation temperature is recommended if a lower pitch rate is used.
  › Similarly, if fermenting at a low temperature, a higher pitch rate (100-150g/hl) is recommended
- **Ethanol production picks up once the yeast starts to metabolize maltose.**
  › Typical attenuation levels are: 70-85%, with a pH range of 3.2-3.5, and Titratable acidity (lactic acid) of: 3-8g/l

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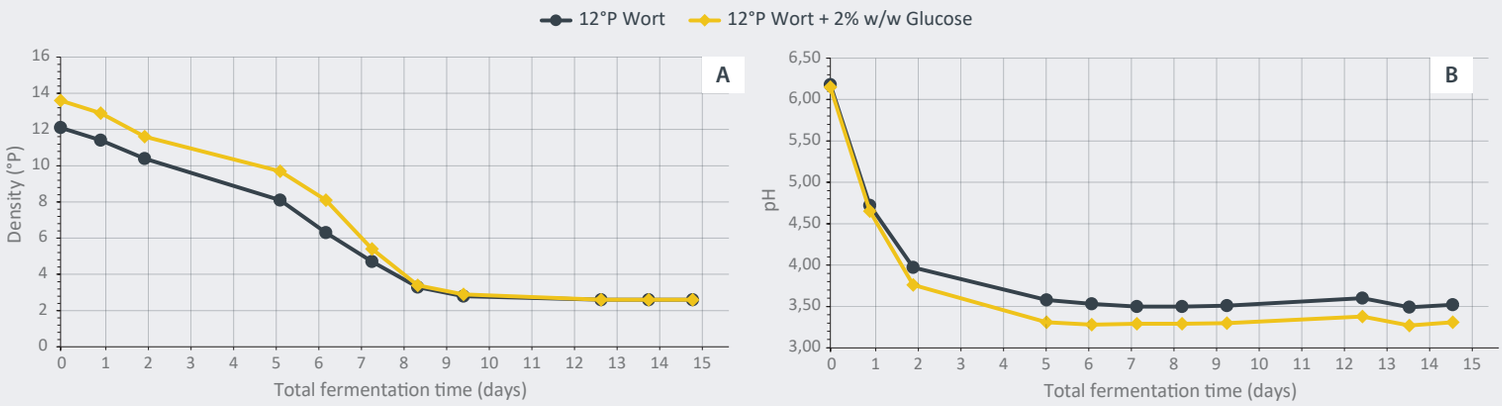
WILDBREW PHILLY SOUR™ WILL PRODUCE LACTIC ACID WITHIN THE FIRST 24-72 HOURS.

FIGURE 1: Lower pH is achieved by adding glucose.

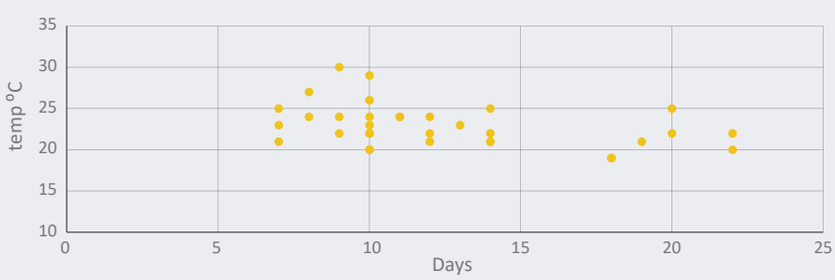


(A) Fermentation kinetics are shown for a standard wort fermentation compared to standard wort + 2% glucose.

(B) Lower pH and higher levels of lactic acid are achieved in fermentations dosed with 2% glucose.

Standard wort was prepared from dry malt extract with hop extract, pitched with 100g/hL **WildBrew Philly Sour™** and fermented at 20°C.

FIGURE 2: Avoid long fermentations by fermenting warmer.



This scatter plot shows the relationship between fermentation time and temperature from commercial fermentations using **WildBrew Philly Sour™**. Starting gravity, wort composition and pitch rate varied for each fermentation. Very long fermentation times usually occur when using a low pitch rate as well as low fermentation temperature. To shorten the fermentation time, it is recommended to increase the fermentation temperature and pitch the appropriate amount of yeast for target gravity. For fermentations at 20°C, brewers can avoid long fermentations by increasing the pitch rate to 100-150g/hL.

ATTENUATION AND ABV CALCULATIONS

Since **WildBrew Philly Sour™** produces both lactic acid and alcohol during fermentation, there are implications for determining the attenuation of the fermentation. When lactic acid is produced, there is no CO_2 released and therefore no loss of mass and no change in density. Therefore, for **WildBrew Philly Sour™** fermentations the FG will be higher, the change in density will be lower and the apparent attenuation determined by measuring density will be lower even if the same amount of sugar is metabolized (real attenuation is the same). The amount of lactic acid is equal to the increase in FG of the beer compared to a similar standard brewing strain.

TABLE 1	STANDARD BREWING STRAIN	WILDBREW PHILLY SOUR™
OG	12°P	12°P
FG	2°P	2.5°P
LACTIC ACID	0 %	0.5 %
APPARENT ATTENUATION	83.3 %	79.2 %
ALCOHOL	5.3 %	5.1 %

TABLE 1: Sample data is shown for calculating abv in a **WildBrew Philly Sour™** fermentation compared to a standard brewing strain. The lactic acid is 0.5% for the **WildBrew Philly Sour™** fermentation, which corresponds to a final gravity that is 0.5°P higher than the standard strain fermentation. The calculated abv for the **WildBrew Philly Sour™** fermentation is lower because the change in density (OG – FG) is lower. The abv can be calculated as normal using standard calculators. The decrease in apparent attenuation resulting from the presence of lactic acid (higher FG) corresponds to a decrease in the calculated abv.