Berliner Weisse

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Die Berliner Weiße – Ein Stück Berliner Geschichte

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What is Berliner Weisse?

- Top-Fermenting beer brewed traditionally with barley and wheat malt. The beer is usually pale in color, mildly acidic and ideally with a thick, stable head of foam
- Most commonly brewed as a „Schankbier", that is a beer of between 7° - 10° Plato original gravity. (Pre 1993 from 7-8° Plato) Traditionally other strengths were brewed from „Vollbier" 11- 14 ° Plato and „Starkbier" 16° and more.
- Undergoes an additional lactic bacteria fermentation which gives the acidic character to the beer.
- Traditionally contained Brettanomyces bruxellensis as secondary fermentation yeast.

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Properties of “Berliner Weisse”

- Refreshing because of its mild and acidic character
- Low alcohol content (< 3 %)
- High content of lactic acid (L(+)-lactic acid)
- May contain living cells of lactic acid bacteria (depending on production procedure)
- Contains yeast with vitamins of B group
- Very good flavor stability
- Bottle fermentation is possible
- Sour, yeasty, apple aroma, very sour, tastes like cider
- Medium body, very high carbonation
- Apple taste, fairly sweet

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Characterization of “Berliner Weiße”

- Unfiltered, high carbonated more or less sour light beer with low bitterness and a more or less sour character with a fine estery and fruity flavor
- Main analytical data:

– Original gravity	7 – 8 %
– Final degree of attenuation	85 – 87 %
– Alcohol	2.5 – 3.0 % vol
– Bitterness	< 10 EBU
– CO_2-content	6 – 7 g/L
– Colour	3 – 5 EBC units
– Lactic acid content	2.0 – 4.0 g/L

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Brief Historical Background

- The Genesis of Berliner Weisse is probably a mix of Berlin, other German and French Brewing styles.
- After the 30 Years War and plague, Berlin‘s need for new citizens was partially filled by French Hugenots.
- The beer we know as Berliner Weisse probably began to appear in the 18th century.
- At its high point in the late 19th century it was the single most popular beer in Berlin and surrounding areas.

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Grist and Mashing Procedure

- Mixture of barley malt and wheat malt
- 65 up to 75% wheat malt

- Traditional mashing procedure:
  - Three mashing procedure
  - Mashing-in temperature 36 – 38 °C (97 – 101 °F)
  - Rest at 44, 60 and 75 °C (111, 140 and 167 °F)
- Modern mashing procedure:
  - Infusion mashing
  - Mashing in 55 – 60 °C (131 – 140 °F)
  - Rest at 66 and 74 °C (151 and 165 °F)

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Wort Boiling

- Heating up wort to 85 °C (185 °F) for 30 minutes (no boiling)
- Alternatively boiling of wort for 15 – 30 minutes
- Low hop dosage
  - Final bitterness less than 10 EBC-Units

- Traditional hopping with natural hops:
  - 750 up to 1000 g hops per 100 kg of malt grist
  - Hop dosage to mash
- Modern hopping:
  - Hop dosage to wort at the beginning of wort boiling

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Fermentation

- Traditionally:
  - Pitching with a mixture of different microorganisms (lactic acid bacteria and yeasts)
  - Traditionally involved different bacteria
  - *Bacillus subtilis*
  - *Pediococcus viscosus*
  - *Lactobacillus delbrückii*
  - *Pediococcus cerevisiae*

- Recommendation:
  - Heating of wort with separate acidification of lactic acid bacteria

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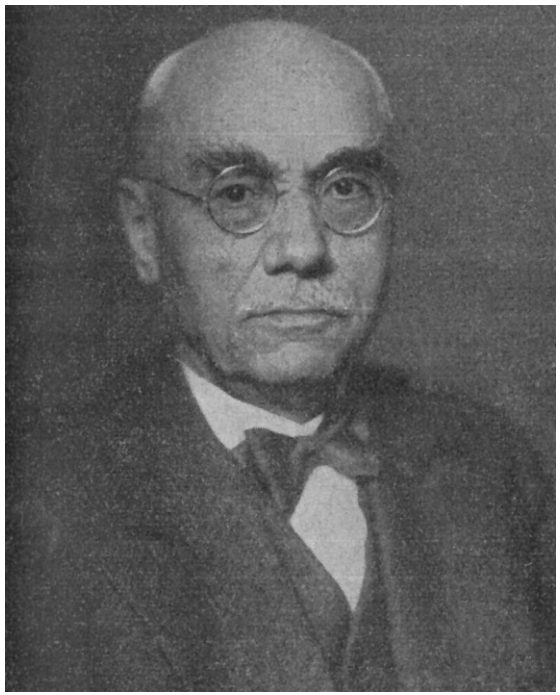
Prof. Dr. Franz Schönfeld: 1866-1940



Source: Tageszeitung f. Brauerei – October 1940

Much of the older data here was gathered by Prof. Dr. Franz Schönfeld.

Director of the Dept. Of Top Fermentation at the VLB Berlin.

Director of the Pilot Brewery at the VLB

Author of many books and articles including his milestone work, „Obergärige Biere und Ihre Herstellung" (Top Fermenting Beers and Their Production) which was published after collecting information regarding top fermentation and production methods from Germany, Belgium, The Netherlands and Great Britain.

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Traditional Production as documented by Schönfeld

- The grist is of a barley malt to wheat malt ratio of 1:3 or 1:4. Of this, the wheat malt is ideally poorly modified or chit malt for foam stability.
- Decoction mashing was preferred over infusion mashing. It was claimed this gave a more intensive flavor.
- Wort was not boiled.
- Hops were only sparsely used. Often added to the mash (boiling during decoction) and to aid lautering.
- Traditionally cooled directly after lautering

Source: Schönfeld, F.: Obergärige Biere und ihre Herstellung; Zweite Auflage; Kap. B 1: Das Berliner Weißbier, Berlin: Verlag Paul Parey 1938

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Traditional Production as documented by Schönfeld

- The souring is accomplished by lactic bacteria which experience showed flourished better in unboiled wort. This however increased the risk of infection (especially with pediococcus).
- Schönfeld himself recommended raising the wort temperature to at least 88° C and suggested a brief boil. Schönfeld claimed that the slight difference in taste was worth the added protection.
- The fermentation was carried out in open fermenters. The use of a pitching vessel was common.

Source: Schönfeld, F.: Obergärige Biere und ihre Herstellung; Zweite Auflage; Kap. B 1: Das Berliner Weißbier, Berlin: Verlag Paul Parey 1938

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Traditional Production as documented by Schönfeld

- In the classic production the primary fermentation is carried to final attenuation and the definitive „ripening" was achieved during bottle conditioning.
- To guarantee a CO_2 content of 0,5 – 0,55%, a volume of 12-15% kräusen was added just before bottling.
- For bottle conditioning, the temperature should be 12 – 16°C for 2 – 3 weeks.
- During the bottle conditioning the characteristic aromas of the Brettanomyces bruxellensis *begin* to develop.

Source: Schönfeld, F.: Obergärige Biere und ihre Herstellung; Zweite Auflage; Kap. B 1: Das Berliner Weißbier, Berlin: Verlag Paul Parey 1938

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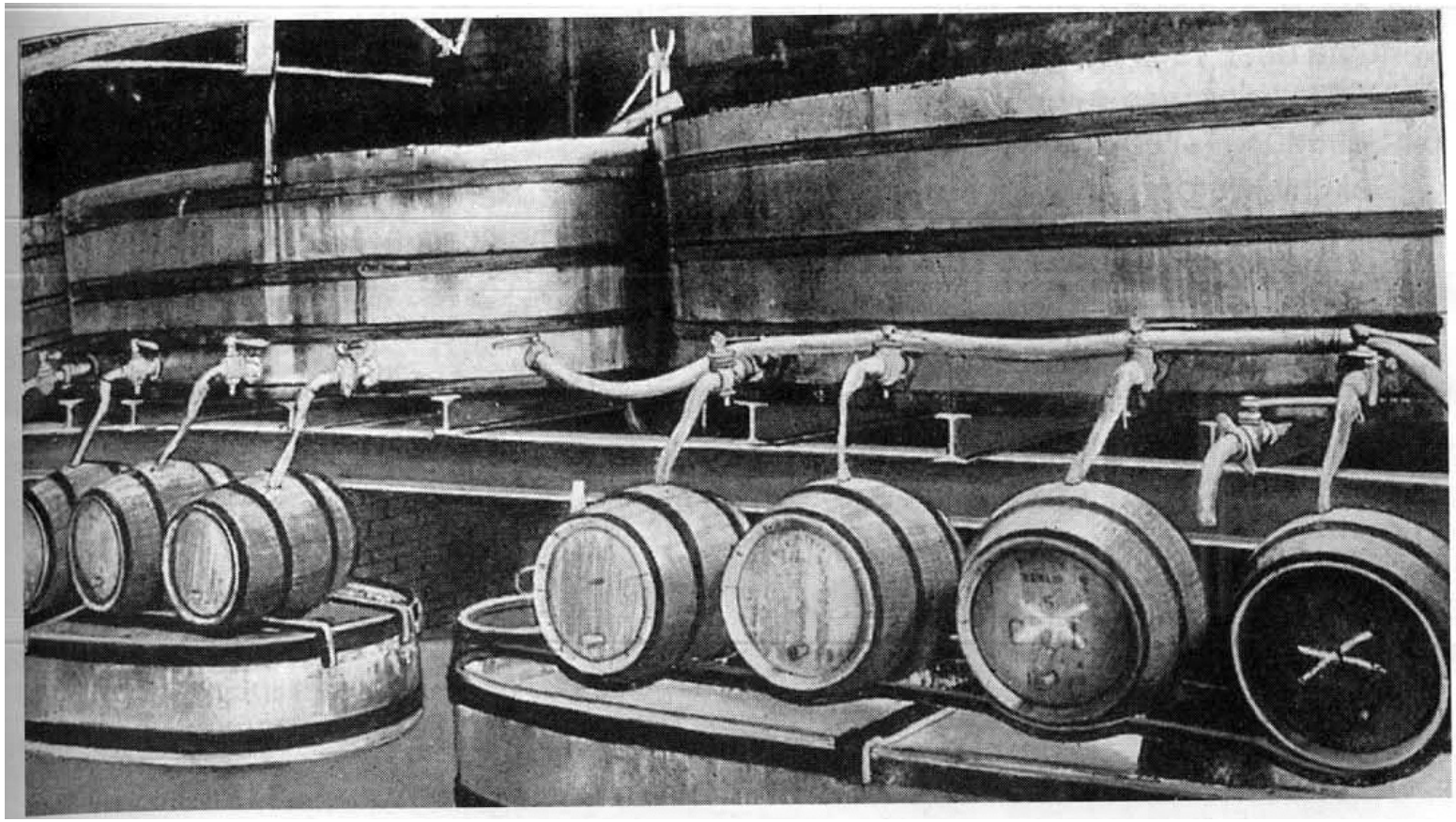
Racking Berliner Weisse to Barrels



Source: Benninghoven, A.: Die Brauindustrie Deutschlands im Bezirk Pankow/Akten Landesarchiv Berlin

Bottle Conditioning of Berliner Weisse ca. 1930

Photo: ABZ -Bildagentur

Microbiology in the Traditional Production as documented by Schönfeld

- As a primary yeast, any top fermenting Saccharomyces cerevesia may be used. All strains showed a similar „symbiosis" with the lactic acid bacteria.
- The ratio of yeast cells to lactic acid bacteria cells is dependant on the fermentation temperature.
- - At higher temperatures (17-20°C) 4:1 yeast to l. bacteria
- - At lower temperatures (14-18°C) 6:1 yeast to l. bacteria
- The „nachsäuerung" or continued acidification during the bottle conditioning was also more pronounced in beers which used a warmer primary fermentation.

Source: Schönfeld, F.: Obergärige Biere und ihre Herstellung; Zweite Auflage; Kap. B 1: Das Berliner Weißbier, Berlin: Verlag Paul Parey 1938

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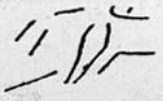
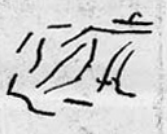
Microbiology in the Traditional Production as documented by Schönfeld

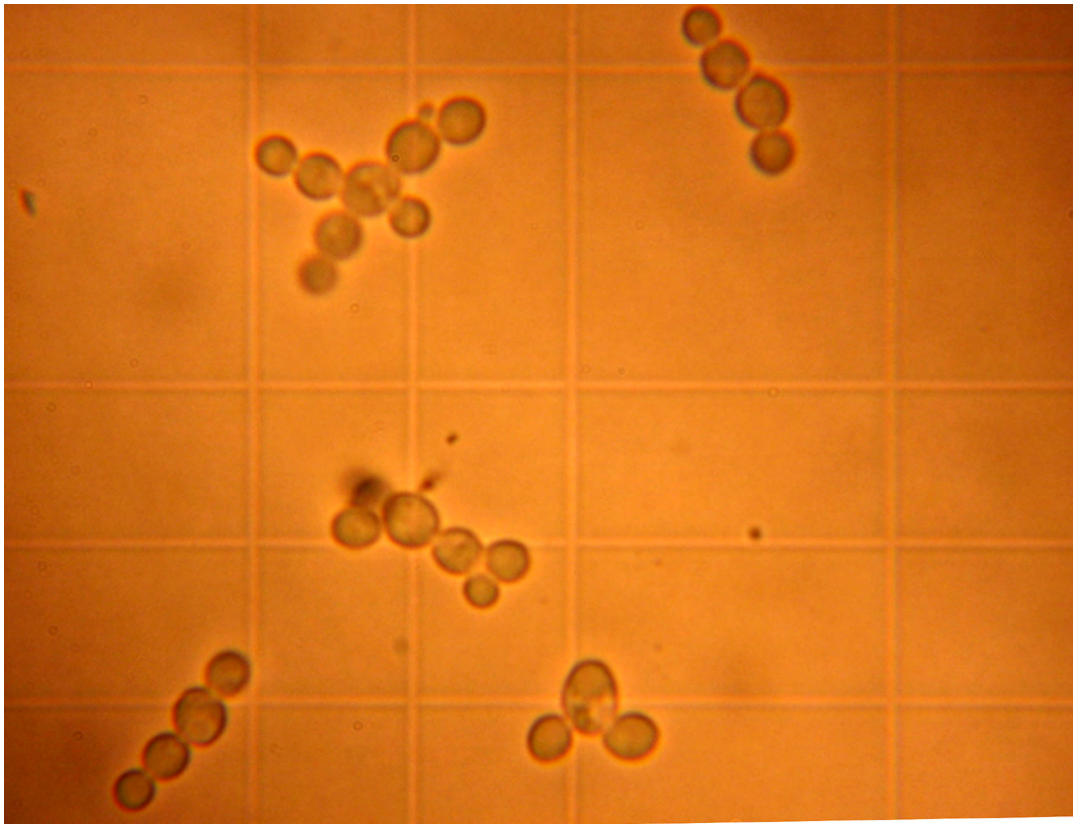
Zeit der Beobachtung, vom Zusatz der Hefengabe an	Prozentgehalt der Würze resp. des gärenden Bieres % E	Anzahl der Hefenzellen in 1/2000 mm³	Anzahl der Stäbchenbakterien in 1/2000 mm³	Temperatur des Bieres ° C	Verhältnis von Hefenzellen zu Stäbchenbakterien	Säure. cm³ Natronlauge zur Neutralisation von 100 cm³ Würze	Aussehen der Stäbchen
Beim Anstellen . .	11	5	1,3	17,5	4 : 1	0,2	
Nach Verlauf von 18 Stunden	10	28	4	19	7 : 1	0,3	
Nach Verlauf von 40 Stunden	5,5	38	11	22	3,5 : 1	1,4	
Nach Verlauf von 64 Stunden	3,0	6 (Hefe ist zum größten Teil schon aufgetrieben)	3,6	23	1,7 : 1	1,8	
Nach Verlauf von 5 Tagen	—	0,5 (schätzungsweise)	0,4	—	—	2,0	

Source: Schönfeld, F.: Obergärige Biere und ihre Herstellung; Zweite Auflage; Kap. B 1: Das Berliner Weißbier, Berlin: Verlag Paul Parey 1938

Microbiology in the Traditional Production as documented by Schönfeld

Point of observation	Apparent Attenuation	Yeast cells / ml	Bacteria cells / ml	Temp. ° C	Ratio of yeast to bacteria	pH
Pitching the yeast	11° Plato	10 * 10E6	2.6 * 10E6	17.5° C	4 to 1	4.74
After 18 hours fermentation	10° Plato	56 * 10E6	8 * 10E6	19° C	7 to 1	4.56
After 40 hours fermentation	5.5 ° Plato	76 * 10E6	22 * 10E6	22° C	3.5 to 1	3.89
After 64 hours fermentation	3° Plato	12 * 10E6 (Note A)	7.2 * 10E6	23° C	1.7 to 1	3.79
After 5 days	End	1 * 10E6 (Note B)	0.8 * 10E6			3.74
		Note A - Yeast is primarily on the surface or skimmed.				
		Note B - Estimated				

Microorganisms of the Berliner Weisse



Saccharomyces cerevisiae

Saccharomyces cerevisiae

- Primary fermentation yeast.
- No mention of special strains used.
- Schönfeld mentions that any top fermenting yeast can be used.

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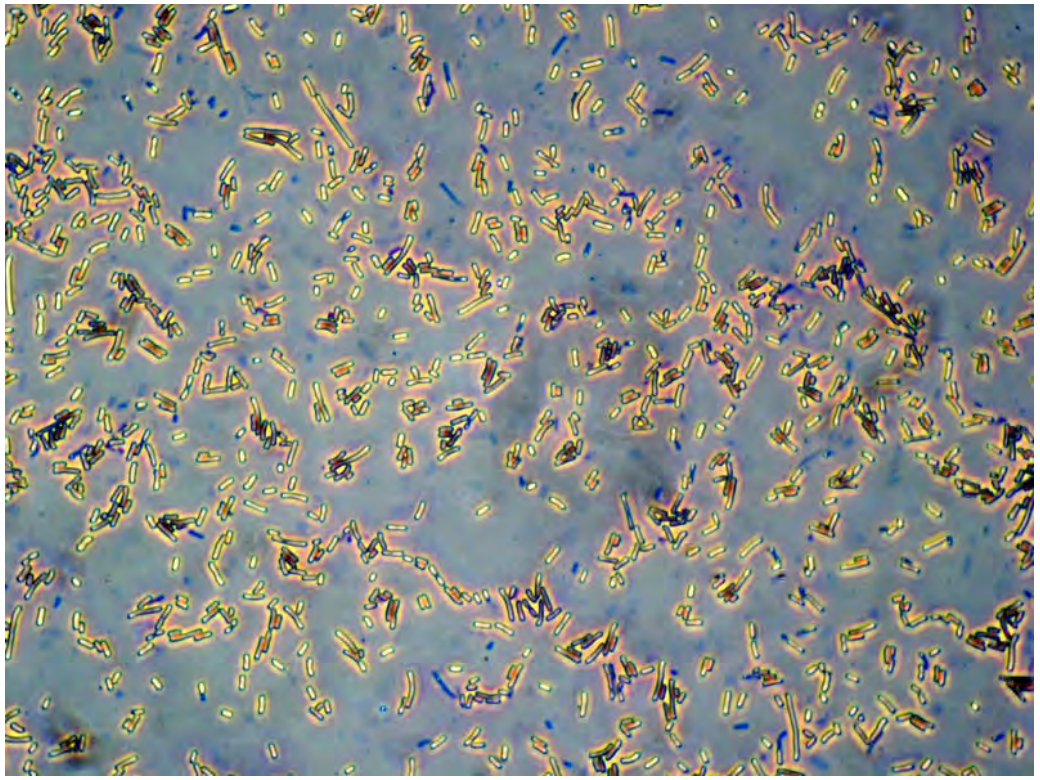
Microorganisms of the Berliner Weisse



Lactobacillus (brevis)

Lactobacillus

- Any number of different lactic acid producing bacteria
- Primarily *Lactobacillus brevis,* a heterofermentative bacteria which produces small amounts of ethanol as well as CO_2 and small quantities of other organic acids.
- Some modern texts (Wackerbauer – Methner) claim that a cell ratio of yeast cells to bacteria cells should be 1:1 - 1:5 in favor of bacteria.
- Other Lacto- bacteria include: *L. lindneri, L. Casei, L.coryniformis and L. plantarum*

Source: Wackerbauer, K and F-J Methner: The Microorganisms of Berliner Weissbier and their influence on the beer flavour – EBC Microbiology Group Meeting, Wuppertal, Germany 13.-15 June 1988

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Lactobacillus according to Henneberg 1909

- Bacteria is very sensitive to hops
- For acidic production the maximum temperature is 38° C, the optimum at 20-24° C, minimum 11° C
- Aside from lactic acid, ethnol, acetic acid, formic acid and CO_2 are formed.
- The presence of ethanol produces; at 3-6% vol. positive growth, at 8% significantly slowed growth, at 10% stasis
- The bacteria were able to assimilate arabinose, glucose, maltose, galactose, saccharose and dextrines
- Not assimilated were: xylose, rhamnose, trehalose, raffinose and lactose

Source: Hennebrg, W.: Gärungsbakteriologisches Praktikum, Betriebsuntersuchungen und Pilzkunde Verlag Paul Parey 1909

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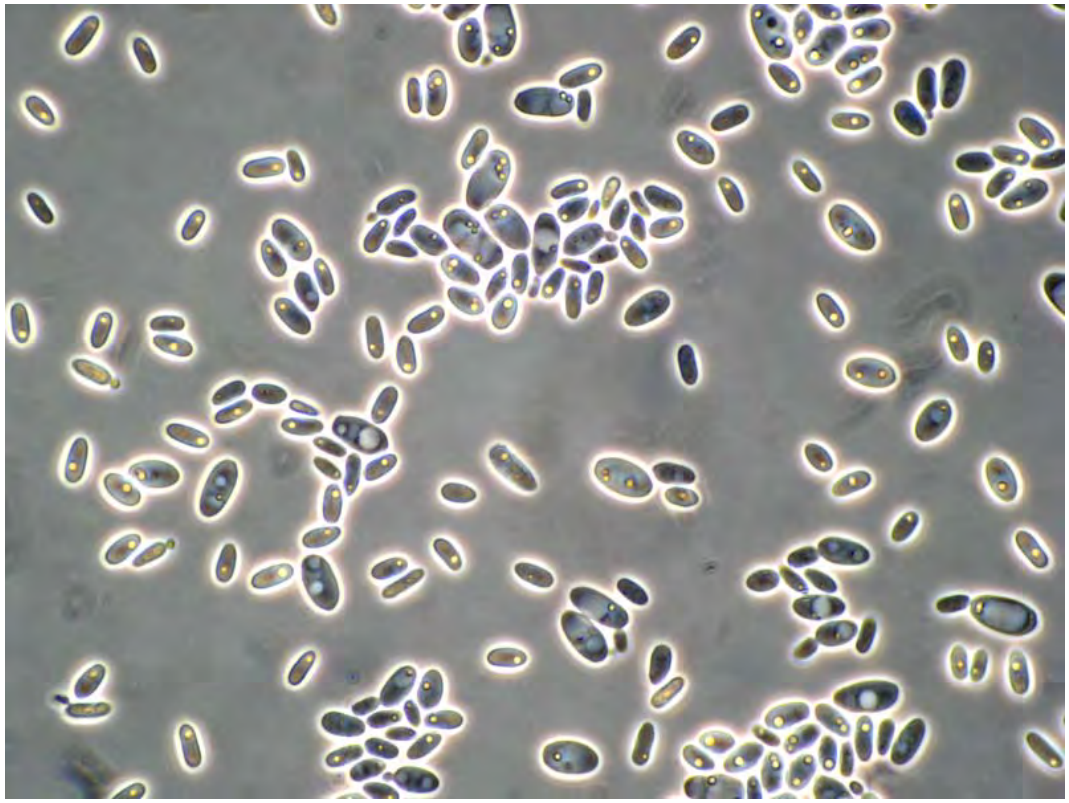
Microorganisms of the Berliner Weisse



Brettanomyces bruxellensis

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Brettanomyces bruxellensis

- Polymorph
- Produces quantities of volatile organic acids.
- In beer with Saccharomyces present, the Brettanomyces continues the fermentation as well as produces acids which react with alcohol to produce esters.
- According to Glaubitz and Koch the yeast is alcohol tolerant up to 15%.

Source: Glaubitz, Koch, Bärwqald: Atlas der Gärungsgewerben; Berlin: Paul Parey, 1930

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Francke Acidification Method - 1906

- Unboiled, unhopped wort cooled to 45-47°C and inocullated with a vital *Lactobacillus delbrueckii* culture. Temperature held until desired pH.
- Wort then heated for 1 hour at 80°C to kill the bacteria.
- Wort cooled, then pitched with cultured top fermenting yeast.
- The secondary fermentation is as in the classic methods.

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Weissbier Culture

Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture

Abbildung 112 Diverse Weißbierglasformen (nach einer Postkarte der „Weißbierstube im Berlin Museum“, Sammlung K.-H. Pritzkow)

1 Stangenform **2** Weißbierschale, zylindrisch („Klauenglas“) **3** Pokal **4** Pokal in Kelchform **5** Pokal, abgesetzt

Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte“

Weissbier Culture

Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture

Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture

A „Doppelweisse in Klauenglas" – 1848 by Ludwig Löffler

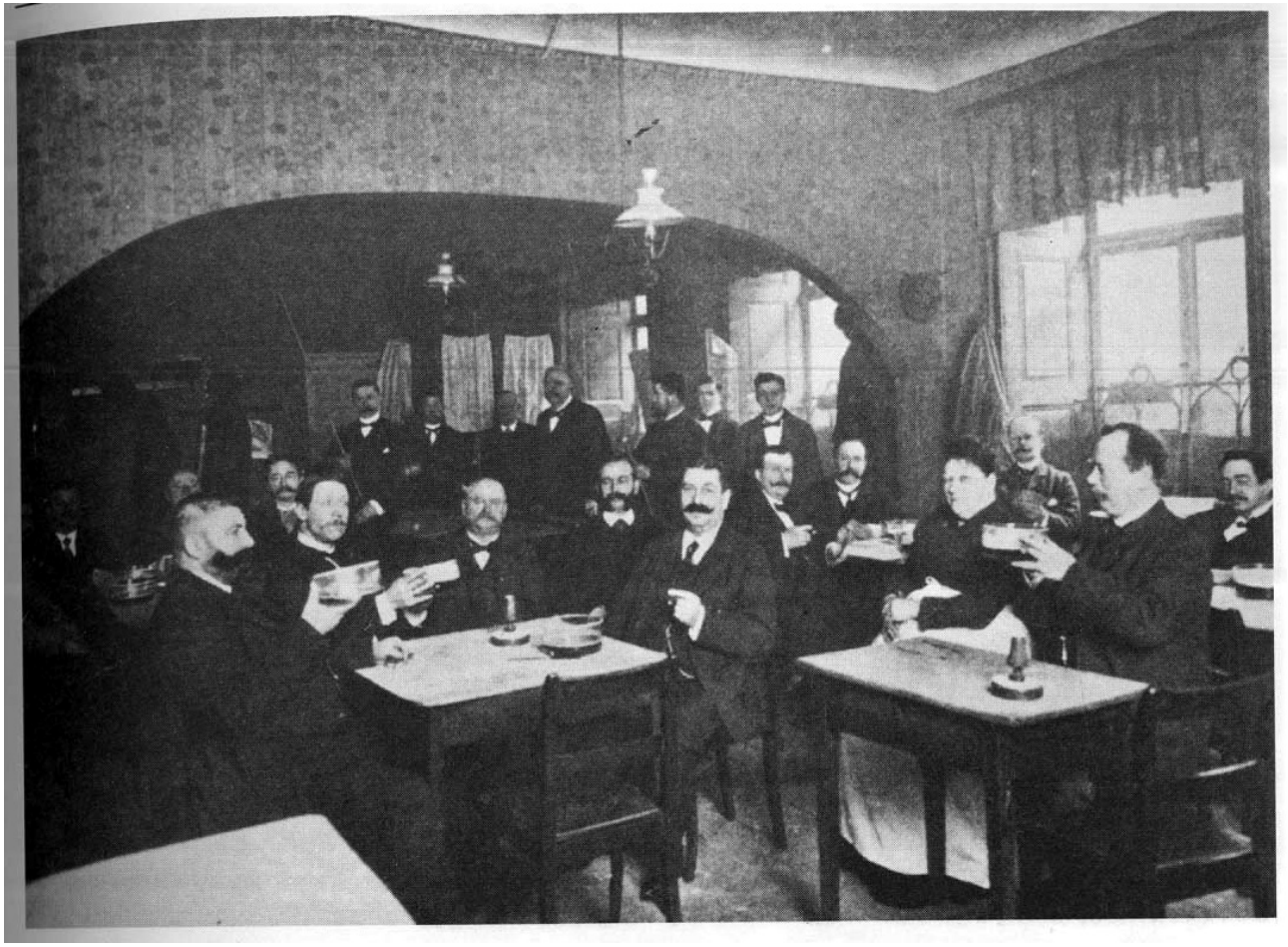
Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture

A round of Weissbier by Gause

Source: Bildarchiv preußischer Kulturbesitz. Bild 20005317. Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture



„The oldest Weißbier pub in Berlin", Charlottenstraße 78, 1903

Source: Klünner Sammlung. Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture

Source: Reproduced from, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Weissbier Culture – Small Lexicon

- Doppelweisse / Vollweisse – Berliner Weisse „vollbier“ 11-14% original gravity.
- „one from the wooden shelf“ – A vintage Weissbier; 3, 5, 7, 9, 11 years old. Also called Edelweisse, Champagne Weisse or Rieslingweisse
- Sandweisse – Bottle of Berliner Weisse which had been buried in sand for several years.
- Steinweisse – Similar to „Sandweisse“ a stoneware bottle which had been buried several years.
- A spoiled or too highly acidic, undrinkable Weisse was called a „Nullweisse“ (Zero Weisse)
- A very popular way of enjoying Weisse was with glass of carraway schnaps. This was known as „Weisse mit Strippe“

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Weissbier Culture – Special Types of Weissbier

Source: label collection Thomas Fricke, reproduced in, „Die Berliner Weiße – Ein Stück Berliner Geschichte"

Problems With Traditional Production

- Bottle conditioning is time intensive and presents internal logistic challenges. Requires large conditioned rooms.
- Mixed cultures are difficult to keep constant over long periods of time causing a lack of consistency and continuity.
- The longer the product stays in the bottle the more intense the further acidification may become.
- The production of consistent and pleasantly acidic Weissbier with a reproduceable aroma and flavor is possible but requires substantial effort.

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Barrach Production Method - 1956

- 80% of the wort is to be pitched with a harvested, mixed culture. This should preserve the character of the previously produced batches.
- The other 20% shall be innoculated with a culture of *L. pastorianus* var. *berolinses* (or *L. brevis*) and incubated at 30°C Using this method of separation the pH can be adjusted and fixed.
- These batches can then be mixed with kräusen and bunged to achieve a CO2 saturation of 0,55%.
- After a short lager period this can be sterile filtered to prevent any futher change and then filled in bottles and barrels.

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Production methods 1978 /1979

	Brewery I	Brewery 2	Brewery 3
Grist	Barley Malt & Wheat Malt	100% Barley Malt	100% Barley Malt
Mashing Procedure	Infusion	1 Mash Decoction	Infusion
Bittering	75g cone hops added to mash / 10 hl cast wort	63g hop extract (25% alpha) / 10hl cast wort	50% wort boiled, hops added, cooled and pitched with yeast. 50% wort unboiled and innoculated only with lactic bacteria culture
Wort Boiling and Wort Cooling	Wort not boiled. Directly from lauter tun and cooled into fermentation vessel	Wort boiled for 5 minutes	
Microorganisms	„VLB Mixed Culture" of top fermenting yeast and several strains of lactic bacteria	„VLB Mixed Culture" of top fermenting yeast and several strains of lactic bacteria	Top fermenting yeast and lactic bacteria cultures added seperately.
Pitching	Total Brew, 0.1 l yeast / hl	Total Brew, 0.5 l yeast / hl	Fermentation 50% of brew in CCT at 20°C, 50% of brew in CCT at 45-47°C
Pitching Temperature	Ca. 18°C	Ca. 20°C	

Source: Dietz, M.: Die Stofflich Veränderung der Berliner Weisse bei der Lagerung – Diplomarbeit TU Berlin, Fachbereich Lebensmitteltechnologie 1979

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Production methods 1978 /1979

	Brewery 1	Brewery 2	Brewery 3
Primary Fermentation	18° C in open fermenter	Without cooling 20 – 25° C, 2-4 days in open fermenter.	20-22° C yeast fermentation. Lactic fermentation ca. 2 days until reaches pH 2,9-3,1, Es 6-6,5%
Conditioning	1st step: Hosed into lager tank for acidification. 2nd step: adding kräusen to 2% extract for bottle conditioning.	Hosing to lager tank with 2 - 2.4% fermentable extract for acidification. Before filling kräusening to 1.8 – 2%.	Depending in the lactic pH, the two parts will either be mixed 50/50 or 60/40. Then 1 week lagering at 15°C under pressure.
Bottle conditioning	4-6 weeks at 15-20° C	4-6 weeks 20° C	No bottle conditioning. Beer is then coarsely filtered and cabonated. No further changes in product.
Desired CO_2 content.	0.6 – 0.7 % CO_2	N/A	

Source: Dietz, M.: Die Stofflich Veränderung der Berliner Weisse bei der Lagerung – Diplomarbeit TU Berlin, Fachbereich Lebensmitteltechnologie 1979

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Production Analysis 1978 /1979

	Brewery 1	Brewery 2	Brewery 3
Original Gravity ° Plato	7.22 – 8.06	7.52 - 7.65	7.42
Ethanol Content v/v	2.83 - 3.28%	2.6 - 2.8%	2.32
Real Extract	1.24 - 1.59%	1.96 - 2.21%	2.8%
pH	3.36 - 3.55	3.45 – 3.79	3.28
Carbohydrates	0.23 – 0.41 g/ 100 ml	0.46 – 0.50 g/ 100 ml	1.56 g/ 100 ml
Acetic Acid	0.21 – 0.58 g/l	0.43 – 0.65g/l	0.09 g/l
D/L Lactic Acid	1.28 – 2.39 g/l	0.98 – 1.72 g/l	2.1 g/l
IBU	4.7 – 6.5	5 - 9	3.4

Source: Dietz, M.: Die Stofflich Veränderung der Berliner Weisse bei der Lagerung – Diplomarbeit TU Berlin, Fachbereich Lebensmitteltechnologie 1979

One Suggestion for Modern Production

- Microorganisms: Saccharomyces cerevisiae, Lactobacillus casei, Brettanomyces bruxellensis
- Wort unboiled, unhopped, Lacto fermentation first to the desired pH, and then thermically inactivated before yeast fermentation.
- Beer is fermented to final apparent attenuation after which the Brettanomyces is pitched to achieve a concentration of $5x10^6$ / m
- This is based primarily on the Francke method

Source: Methner F.-J.: Über die Aromabildung beim Berliner Wei?ßbier unter besonderer Berücksichtigung von Säuren und Estern, Diss., TU Berlin, 1987

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VLB- Berliner Weiße Quality evaluation

VLB- Berliner Weiße Quality sheet		
Characteristic	**Points**	**Property**
Appearance	**5**	Bright to slight haze, Sediment compact precipitated
	4	Slight hazy, sediment precipitated
	3	Turbid, sediment in part loose
	2	Very turbid; heavy loose sediment
	1	Heavy turbidy, flower formation
	0	Nauseous, impurities

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VLB- Berliner Weiße Quality evaluation

Foam	**5**	Very abundant, white, creamy, stable
	4	Abundant, fine pored, white stable
	3	Moderate amount, coarsely porous, sufficient stability, slightly yellowish
	2	Amount too low, very coarse porous, instable
	1	No foam formation
	0	---

VLB- Berliner Weiße Quality evaluation

Aroma / Odour	**5,0**	Aromatic, pure, clearly distinctive fruity/vinous, well balanced decent acidity, slight yeasty, very harmonic
	4,5	Aromatic, pure, distinctive vinous-fruity, decent acidity, slight yeasty, harmonic
	4,0	
	3,5	Insufficient aromatic, pure, weak vinous-fruity, weak yeasty, slight inharmonic
	3,0	Weak aromatic, not pure, yeasty, unilateral acidic, not harmonic
	2,0	Too weak in aroma, impure, accented yeasty, slight vinegar note, impure acidic
	1,0	Very impure, very yeasty, vinegar note
	0	Vinegar note, strange

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VLB- Berliner Weiße Quality evaluation

Taste	**5,0**	Fully aromatic, pure, clearly distinctive vinous-fruity, very harmonic balanced acidity, mild bitterness, very sparkling
	4,5	Aromatic, pure, distinctive vinous-fruity, harmonic balanced acidity, mild bitterness, sparkling
	4,0	Aromatic, pure, less fruity, not totally balanced acidity, not totally balanced bitterness, sparkling
	3,5	Insufficient aromatic, pure, weak or too strong bitterness, sparkling
	3,0	Weak aromatic, not pure, yeasty, strong acidic, weak or dominant bitterness, less sparkling
	2,0	Too weak in aroma, impure, accented yeasty, unilateral too strong bitterness, flat in fizziness
	1,0	Empty, very impure, damp, slight vinegar note
	0	Vinegar sour, strange

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