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ALE/LAGER PITCHING RATES

There are many good published yeast guides and a number of excellent books on the science of yeast that also include the metrics of creating stir-plate starters. We highly recommend Chris White and Jamil Zainasheff's volume for detail and academics[1]. This document is intended to be a quick reference sheet for selecting the correct pitch rate for most gravities.

Cell Count

Identifying the ideal cell count, (pitch rate), is necessary for controlling the duration of fermentation and the quality of ester/phenol development. The figure below illustrates common densities of yeast cells per milliliter using three starter methods. For the brewer without a lab, yeast starters are based on an assumption of cell count within a vial or yeast pack. A White Labs vial of yeast will contain approximately 80-120 billion cells depending on the production date. This count estimate is the basis for the build-up of yeast cells for a starter. The chart below is an illustration of yeast densities per harvest method[2]:

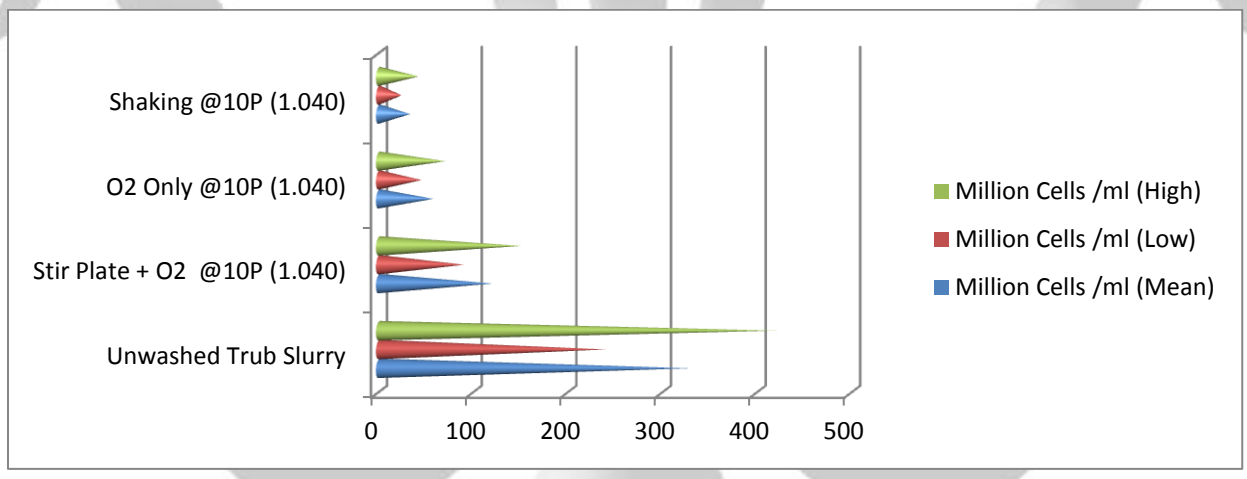

Figure A: Estimated Yeast Cells /ml

[1] White, Chris, Zainasheff, Jamil. "Yeast, The Practical Guide to Beer Fermentation". © 2010, Brewer's Association.

[2] Note: Yeast from unwashed or washed trub poses a set of fermentation and hygiene problems not addressed in this reference sheet. Unwashed trub is not recommended for pitching and is used here for comparison only.

Knowing the average cell count per milliliter in a stir-plate starter makes choosing a yeast pitch rate simpler. Table 1.0 below details the cell count required for many common gravities of ales/lagers. A pitch rate in this chart always assumes healthy yeast, proper stir-plate temperature, and growth in nutrient balanced oxygenated 10P wort. With a starting gravity in mind we can formulate a stir plate starter size, a starter inoculation rate, (seed rate), and project an estimated final cell count to attenuate our ale. The chart below is a working model based on industry calculations but is also modified by working practice. Whether you use the White/Zainasheff model for projecting cell counts or the Troester model will be up to the user. We've used the Zainasheff/White method quite successfully.

Pitch Rate

The phrase *starter size* can be somewhat misleading. For instance, a 1000ml stir-plate starter can have a *range* of cell counts and may produce *varying* yeast quality depending on the starter inoculation rate, starter gravity, and cultivation method. The table below presumes pitch rates for a 5.00 gallon batch, a healthy 10P wort infused with O_2, proper temps for yeast growth, the requisite yeast inoculation of at least 30% of target total and time for cultivation, (18-24 hours).

To the right of the ideally calculated pitch rate is a common under-pitch rate of minus 20%, (optional for increasing ester development).

	Ale (Saccharomyces cerevisiae)				**Lager** (Saccharomyces pastorianus)			
OG	*Standard Pitch Rate (Billions)*	*Under-Pitch Rate (-20%)*	*Starter Seed Rate (billions)*	*Approx. under-pitch starter size (ml)*	*Standard Pitch Rate (Billions)*	*Under-Pitch Rate (-20%)*	*Starter Seed Rate (Billions)*	*Approx. under-pitch starter size (ml)*
1.037	139	111	33	**1088**	208	167	55	**1632**
1.038	143	114	34	**1117**	214	171	56	**1676**
1.039	146	117	35	**1147**	219	176	58	**1720**
1.040	150	120	36	**1176**	225	180	59	**1764**
1.041	154	123	37	**1205**	231	185	61	**1808**
1.042	158	126	38	**1235**	236	189	62	**1852**
1.043	161	129	39	**1264**	242	194	64	**1896**
1.044	165	132	40	**1294**	248	198	65	**1940**
1.045	169	135	41	**1323**	253	203	67	**1985**
1.046	173	138	41	**1352**	259	207	68	**2029**
1.047	176	141	42	**1382**	264	212	70	**2073**
1.048	180	144	43	**1411**	270	216	71	**2117**
1.049	184	147	44	**1441**	276	221	73	**2161**
1.050	188	150	45	**1470**	281	225	74	**2205**
1.051	191	153	46	**1499**	287	230	76	**2249**

1.052	195	156	47	**1529**	293	234	77	**2293**
1.053	199	159	48	**1558**	298	239	79	**2337**
1.054	203	162	49	**1588**	304	243	80	**2381**
1.055	206	165	50	**1617**	309	248	82	**2426**
1.056	210	168	50	**1646**	315	252	83	**2470**
1.057	214	171	51	**1676**	321	257	85	**2514**
1.058	218	174	52	**1705**	326	261	86	**2558**
1.059	221	177	53	**1735**	332	266	88	**2602**
1.060	225	180	54	**1764**	338	270	89	**2646**
1.061	229	183	55	**1793**	343	275	91	**2690**
1.062	233	186	56	**1823**	349	279	92	**2734**
1.063	236	189	57	**1852**	354	284	94	**2778**
1.064	240	192	58	**1882**	360	288	95	**2822**
1.065	244	195	59	**1911**	366	293	97	**2867**
1.066	248	198	59	**1940**	371	297	98	**2911**
1.067	251	201	60	**1970**	377	302	99	**2955**
1.068	255	204	61	**1999**	383	306	101	**2999**
1.069	259	207	62	**2029**	388	311	102	**3043**
1.070	263	210	63	**2058**	394	315	104	**3087**
1.071	266	213	64	**2087**	399	320	105	**3131**
1.072	270	216	65	**2117**	405	324	107	**3175**
1.073	274	219	66	**2146**	411	329	108	**3219**
1.074	278	222	67	**2176**	416	333	110	**3263**
1.075	281	225	68	**2205**	422	338	111	**3308**
1.076	285	228	68	**2234**	428	342	113	**3352**
1.077	289	231	69	**2264**	433	347	114	**3396**
1.078	293	234	70	**2293**	439	351	116	**3440**
1.079	296	237	71	**2323**	444	356	117	**3484**
1.080	300	240	72	**2352**	450	360	119	**3528**
1.081	304	243	73	**2381**	456	365	120	**3572**
1.082	308	246	74	**2411**	461	369	122	**3616**
1.083	311	249	75	**2440**	467	374	123	**3660**
1.084	315	252	76	**2470**	473	378	125	**3704**
1.085	319	255	77	**2499**	478	383	126	**3749**
1.086	323	258	77	**2528**	484	387	128	**3793**
1.087	326	261	78	**2558**	489	392	129	**3837**
1.088	330	264	79	**2587**	495	396	131	**3881**
1.089	334	267	80	**2617**	501	401	132	**3925**
1.090	338	270	81	**2646**	506	405	134	**3969**
1.091	341	273	82	**2675**	512	410	135	**4013**

1.092	345	276	83	**2705**	518	414	137	**4057**
1.093	349	279	84	**2734**	523	419	138	**4101**
1.094	353	282	85	**2764**	529	423	140	**4145**
1.095	356	285	86	**2793**	534	428	141	**4190**
1.096	360	288	86	**2822**	540	432	143	**4234**
1.097	364	291	87	**2852**	546	437	144	**4278**
1.098	368	294	88	**2881**	551	441	146	**4322**
1.099	371	297	89	**2911**	557	446	147	**4366**
1.100	375	300	90	**2940**	563	450	149	**4410**

Table 1: Yeast Pitch Rates

A Sample Starter: Westvleteren 12 clone @ 1.090 PPG

When trial brewing a Belgian ale, (such as a Westvleteren 12 clone), outside a formal lab, the pitch rate is *estimated* by cell count based on a presumed seed count, (White Labs vial, Wyeast smack pack, Fermentis dry pack, etc.). A starter plan is created to match the appropriate pitch.

Westvleteren 12 clone OG: 1.090
Estimate of Required Cells: 338 billion
Estimated under-pitch: 270 billion
Starter Plan: Prepare 2700ml sterile 10P oxygenated wort with recommended nutrient. Pitch 1.00 vial, (80-100 billion cells) of White Labs *fresh* yeast, or Wyeast smack pack, or dry pack. Diffuse O_2 in wort for 20 seconds, pitch the inoculation yeast, then initiate stir plate. After 6 hours repeat O_2 diffusion. At 18-24 hours the yeast will have consumed the wort and replicated to 260-270 billion cells based on the estimate of the seed rate cell count. Magnetically remove the stir-bar, chill for 12+ hours, decant the starter liquid from the flocculated yeast down to about 200-300 ml. Just prior to brew day let the yeast warm up to pitch temperature (64-68F) for 8-12 hours. Add some of the chilled sterile wort from the brew to the flask and mix to assure all of the yeast is in suspension before pitching.

Primary Observation: Ferment at the manufacturers recommended temperatures, (or your experientially proven temps for the profile you're after). Observe the fermentation closely and record the time to FG. If attenuation to target FG took only 3 days then the pitch must be reduced until the duration is appropriate for the style. The Westvleteren 12 clone for instance should reach FG in about 6-7 days. If fermentation took 12 days then the pitch health and size should be refactored until it matches the fermentation timeline.

Notes: Most non-sour ales should complete primary fermentation in about 5-8 days and lagers in 3-5 weeks depending on the style. Extended primary durations are not recommended. After primary, the ale should be removed from the yeast cake, (yeast dump or rack to secondary). Most stated secondary temps for Belgian ales are anywhere from 34F to 60F. It is important to keep in mind that secondary for

a Belgian ale halts aggressive fermentation, maintains and matures the ester/phenolic profile, and begins to clarify the ale. Secondary temps are highly subjective to yeast strain and style of ale.